By the same author

Process and Unreality

Pragmatism: Philosophy of Imperialism

PAVLOV AND FREUD: I

IVAN P. PAVLOV

Toward a Scientific Psychology and Psychiatry

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209

CONTENTS

PREFATORY NOTE

The present volume, Part I of *Pavlov and Freud,* is an attempt to introduce the reader to those teachings of Ivan P. Pavlov which are pertinent to the fields of psychology and psychiatry. Pavlov founded a new science, the physiology of the higher nervous activity, primarily concerned with the functioning of the cerebral cortex, as the organ of mental life. This science is not as yet well known in the United States, and in the interest of making it more readily available this work is offered.

The new science is by no means a finished product, but there are already sufficient facts, and generalizations based on them, to make a convincing case. It is the contention of the Pavlov "school" that to become fully experimental, psychology and psychiatry must be firmly rooted in the physiology of the brain. Especially in view of the critical problem of mental illness in our country, it is encumbent on us to investigate all relevant scientific claims. This book seeks to present the claims of the Pavlovian science of higher nervous activity.

H. K. W.

Chapter I

INTRODUCTION

PSYCHOLOGY IS THE STUDY of the mental activity and personality of man. Its aim is to discover the facts and laws of human nature. It is man's attempt to understand himself.

The subject matter of psychology is close to all of us. There is, perhaps, more natural interest in it than in any of the other sciences. For it deals with such familiar things as: sensation, perception, attention, memory, imagination, speech, thought, feelings and emotions, character and personality traits, habits of work and play, and personal and social relationships.

There are many branches of psychology: general psychology, child psychology, educational psychology, industrial psychology, and others.

These fields are concerned with the understanding of human nature that it may be changed; that we may understand the development of the child and can better prepare him for school and adult life; that we may understand the learning process and the formation of character in the school years; that we may know ourselves as adults and develop our capacities to their fullest extent; and that we may live together in family and social relationships that allow at once for the greatest unity and individual development.

There are, therefore, vitally important tasks which psychology must carry out.

In addition, there is psychopathology, the study of mental illness, with the medical science of psychiatry to heal the sick. In our country there is a tremendous interest in this field, for the incidence of mental illness constitutes the highest of threats to the health of our people. The National Institute of Mental Health reported in July 1954, that "Mental hospitals today care for as many patients as all other kinds of hospitals combined."[1] This, of course, does not reflect the countless tens of thousands

who never reach hospitals but are treated, if at all, in the offices of psychiatrists.

Thus psychology, together with its medical departments of psychopathology and psychiatry, is of vital concern to all people. It is of first-rank importance that this science be a real science, that it be based on true principles and follow exact scientific methodology. For, if it does not, if, rather, it misleads, then it can be most harmful to the life interests and health of millions on millions of people. It can act as a most effective brake on progress, a diverter and distorter. Or it can act as a great liberating and constructive force. Much depends on our having a true science of psychology.

But psychology is a young science, the youngest, in fact. It was the last of the great areas of human knowledge to break away from that most abstract of all disciplines, philosophy. Whereas the other natural and social sciences are all at least one hundred years old, and some much older, psychology is not much more than half a century in existence as an independent science.

For some 2,500 years psychology was largely the province of the philosophers and theologians, from the early Greeks down to the threshold of the twentieth century. It consisted primarily in speculation about the nature of the soul, or mind, and its relation to the body. The great thinkers of the past were sharply divided on this crucial question. On one side were the materialists who held that mind was inseparable from and dependent on body. A long speculative tradition tracing from the early Greek philosophers, Democritus and Epicurus, and the medical doctors, Hippocrates and Galen, to the materialists of the British, American and French revolutions, supported and elaborated this view. On the other side were the idealists, from Plato and St. Augustine to Bishop Berkeley who maintained not only that mind was separable from body but that in one form or another body was dependent on mind.

Toward the middle of the nineteenth century three new influences were brought to bear on the field which eventually led to the declaration of the independence of psychology from philosophy.

In the first place, new developments in physics, particularly

with regard to optics and sound, led a number of German physiologists to investigate the human eye and ear. Johannes Müller, Ernst Heinrich Weber and Herman von Helmholtz, among others, made significant contributions to the psychology and physiology of sensation and perception. Here for the first time psychology was more closely related to physiology than to philosophy.

In the second place, Charles Darwin, himself, outlined some implications of the new evolutionary biology for psychology. He showed in his *Descent of Man* that the human brain evolved from lower forms and that many mental capacities can be traced to animal origins. He wrote a book on the *Expression of The Emotions in Man and Animals* indicating the evolution of human emotions. Here psychology was more closely related to biology than to philosophy.

In the third place, under the influence of the current queen of the sciences, physics, Gustave Theodore Fechner and Wilhelm Wundt introduced the experimental method into the study of psychology. Wundt established the first official psychology laboratory in 1879. Both Fechner and Wundt were primarily concerned with the physiological investigation of sensation and perception carried on by means of controlled experiments. Students from many countries flocked to the Wundt laboratory in Germany and took the experimental approach back to their homelands. The first laboratory in the United States for the study of psychology was founded at Johns Hopkins University in 1881 by G. Stanley Hall, a student of Wundt. With the introduction of the experimental method, psychology was more closely related to science than to philosophy.

The three influences of physiology, biology and the experimental method led gradually in the course of the last half of the nineteenth century to the weaning of psychology from its maternal ties to philosophy. In our country, the break-away was expressed by the establishment, between the years 1881 and 1900, of departments of psychology in most of the major colleges and universities. Heretofore psychology had been taught almost exclusively by philosophers and theologians, and for the greater part by theologians who were also presidents of the institutions—a testimony to the importance of the question of the re-

lation of mind to body, closely related as it is to such vital church doctrines as the special creation of the soul and life after death.

In the half century or more since psychology became an independent discipline literally hundreds of "schools" of thought on the subject have arisen. Groups and splinter groups, and splinters of splinters developed. Among the better known "schools" were: genetic psychology, structuralism, functionalism, dynamic psychology, hormic psychology, psychoanalysis, gestalt psychology, operationism, factorial analysis, semantics, neo-scholastic psychology, conditioned reflex psychology, and the specifically U.S. school of behaviorism.

Out of the bewildering array of "schools" and their subdivisions, a tendency has developed in the past twenty years toward polarization around two approaches to the subject, the objective and the subjective or introspective. The central figure in the former is Ivan P. Pavlov, the great Russian physiologist, while the dominant figure in the latter is Sigmund Freud, the famous Viennese physician. The two poles, each year becoming more powerfully magnetized in attracting the psychological particles, are Pavlovian conditioned reflex psychology and Freudian psychoanalysis. These two diametrically opposed schools more and more dominate the world scene in the field of psychology. Each claims to have discovered the true scientific approach to the study of man's mental life. Further, each has had, and continues to have, a growing powerful influence in various parts of the world on many other areas of human activity.

In general, the center of the Pavlovian conditioned reflex approach is in the Soviet Union, together with the People's Democracies of Eastern Europe and Asia. But strong theoretical and medical forces gravitate toward it in Great Britain and Western Europe as well as in the United States.

In our country there has been in existence for some twenty-five years the Pavlovian laboratory at Johns Hopkins University under the directorship of W. Horsely Gantt, the translator into English of Pavlov's *Lectures on Conditioned Reflexes and Conditioned Reflexes And Psychiatry,*[2] made available for the first time in English by International Publishers in 1928. The objective approach is by no means a stranger to our shores. As a mat-

ter of fact, one of the earliest attempts to deal with strictly psychological phenomena by means of the objective, experimental method was made by an American, E. L. Thorndike, who published his results in a book called *Animal Intelligence,* in 1898.[3] Of this book Pavlov wrote, "I must acknowledge that the honour of having made the first steps along this objective path belongs to E. L. Thorndike."[4] Since 1898 the experimental approach has won a leading place in American *academic* psychology. Whatever the theory espoused, the main methodological reliance is now the laboratory with its elaborate technical equipment.

In psychiatry also a strong tradition exists in our country behind the objective physiological-medical approach to mental illness, stemming in the first place from the father of American psychiatry, Dr. Benjamin Rush, a signer of the Declaration of Independence. For several decades now this tradition has lain semi-dormant under the impact of psychoanalysis. But in the last few years a definite trend has appeared in certain sections of American psychiatry away from psychoanalysis toward a biological, chemical and physiological approach to mental illness. This shift is due apparently to two stubborn facts: first, the alarmingly high and steadily rising incidence of mental illness in the United States; and second, psychoanalysis has not proved to be an effective therapeutic measure. In addition, technological advances in other scientific fields when applied to mental illness have begun to produce results and no longer can be ignored. A recent and striking example of this is the discovery of two new drugs, chlorpromazine and reserpine, which appear to hold promise for the treatment of mental illness. The discovery of these drugs has given a new and powerful impetus to the trend toward a medical orientation in psychiatry.

The past years have seen renewed interest in the search for biological and physiological facts and theories which could help in the advance toward a scientific psychiatry. A Society of Biological Psychiatry, formed in 1946, is today attracting in our country an increasing following among scientifically thinking psychiatrists. The president of this society, Professor L. J. Medina of the University of Illinois, outlined its point of view in his presidential address: "Our main tenet is that a thing is

what it is—that mental disturbances are disturbances of the brain. All mental disturbances therefore have to be expressed and defined not in terms sociological or religious, or in symbols philosophical and magic-phallic, but in terms physiological and biological."[5] Further confirmation of this general trend is found in the recent formation in the United States of a Pavlovian Society with the explicit purpose of investigating the causes and cures of mental illness along the lines developed by Pavlov. Among the charter members is an impressive roster of leading names in American medicine and psychiatry. Reporting the founding of the Pavlovian Society, the *New York Times* said, "The new society more sharply defines the difference between the Freudian school and that of the late I. P. Pavlov, Russian physiologist and Nobel Prize winner. The Pavlovian or objective psychiatrists believe the study of mental illness must be subject to the same exacting laboratory methods as other branches of medicine and science. The Freudians treat the patient by probing into his childhood and inner consciousness."[6] The delegates to the 1956 annual meeting of the American Psychiatric Association heard a number of papers dealing with mental illness from the physiological and bio-chemical point of view. Two temporary and experimental cases of schizophrenia were reported to have been induced in volunteers by means of injecting a protein substance taken from the blood of schizophrenic patients.[7] Definitely, a new wind is blowing in American psychiatry away from the "purely mental" approach toward a bio-chemical and physiological orientation, and interest in the teachings of Pavlov is no small part of it.

In the Soviet Union and the East European and Asian People's Democracies, and among many groups elsewhere, the Pavlovian conditioned reflex approach is having a profound influence on diverse sciences and institutions. It is bringing about significant developments in the theory and practice of physiology, medicine, psychology, psychiatry, pharmacology, biochemistry, animal husbandry, physical culture, education, and social work.[8]

The center of the Freudian psychoanalytic approach today is in the United States and spreads throughout the world wherever it can penetrate. Here in the past thirty or forty years psychoanalysis has permeated almost all aspects of national life, from

cultural fields such as literature, the theatre and the movies, to education, labor relations, social work, medicine, economics, sociology, anthropology, and many others—and it is still growing and spreading its influence.

Thus two giant figures stand out in the field of psychology, each with powerful influence and backing. Who were these men around whom has focussed such a sharp polarization of thought in the field of psychology? What kind of lives did they lead, what work did they do and what were the principles they taught? What are the differences between the introspective analytical and the objective experimental approaches to the study of the highest achievement of nature, the human mind?

For the answers to these questions we go to a study of the life and work first of Pavlov and then of Freud.

The lives of the two men run concurrently, Freud having been born just seven years after Pavlov. Both span the transformation of psychology into an independent discipline. Pavlov was born in 1849 and died in 1936; Freud was born in 1856 and died in 1939.

Chapter II

IVAN P. PAVLOV

IVAN PETROVICH PAVLOV was born in the old Russian city of Ryazan on September 14, 1849. His father was then a young priest of a poor parish and had to supplement his income by work in the garden and orchard. He was something of an intellectual who loved books and read widely. From him Ivan acquired a love of learning and a respect for scholarship.

Ivan Petrovich started lessons in reading and writing at the age of five from an elderly lady who drilled him with unflagging zeal. But his greatest joy was in working with his father in the garden and orchard, a taste for physical work which he carried through life.

Due to a fall which seriously affected his general health, he did not enter the Ryazan church school until he was eleven. When he finished the elementary course, he entered the local theological seminary.

During Pavlov's student years Russia was going through momentous changes. The middle of the nineteenth century was a turbulent time. The serfs won their freedom in 1861 and the ferment around this issue dominated the intellectual life of the country. It was the period of the revolutionary democrats and enlighteners—Belinsky, Herzen, Chernyshevsky, Dobrolyubov, Pisarev. These men fought against reaction in political life, in culture and in science. Liberalism was the temper of their thought and materialism was their philosophy. This group of revolutionary thinkers had a strong influence on the young Pavlov. Following their articles in the progressive journals and their fiery debates on science, he was imbued with their enthusiasm and their ideas.

The wave of enlightenment and democratic struggle engulfing the country was strongly felt in the theological seminary. Here a number of teachers communicated the new thirst for

learning and science to their pupils. Students and teachers formed a solid front of inquiry. Libraries were jammed and throngs stood in line to read the latest literature. Heated discussions were held impromptu on the streets after reading the new books of the period.

Intellectual excitement was running high, and science stood at the forefront. Science was to lead mankind out of the darkness. In a short autobiographical piece, Pavlov later wrote of this period, "Under the influence of the literature of the sixties, especially Pisarev, our intellectual interests turned to natural science in the University."[1] While still at the Seminary he was strongly moved by two books that were to be permanent influences in his life. The first was *Reflexes of the Brain,* the classic work of the founder of physiology in Russia, I. M. Sechenov, and the second was a textbook on practical physiology.

Under these influences Pavlov rejected his hereditary career in the church and left the seminary without completing the course. He then entered the University at St. Petersburg, where he enrolled in the physics and mathematics department, taking the natural science course. His excellent record and a certificate of poverty brought him a scholarship which covered his living expenses.

At the University Pavlov studied with a number of outstanding teachers. He sat under such professors as Mendeleyev in inorganic chemistry and Buttlerov in organic chemistry. But it was I. F. Tsyon's course in physiology which settled the question of career for him. Tsyon was an extraordinarily skilled experimenter and his tutelage played a big part in making the young Pavlov into one of the greatest experimental scientists of all time. Pavlov's schoolboy interest in physiology developed rapidly into a firm resolve to master the subject. In the *Autobiography* he wrote: "At the time the faculty was in a brilliant state. We had a number of professors of great authority in science with outstanding talents as lecturers. I chose for my major course animal physiology, and took chemistry as a minor. We physiologists were enormously impressed by Tsyon. We were truly fascinated by his ingeniously simple exposition of the most complex physiological questions, and his masterful ability in conducting experiments. One can never forget such a teacher."[2]

While still an undergraduate at the University, Pavlov, under Tsyon's direction and together with another student, conducted his first experimental research. It was concerned with the physiology of the nerves of the pancreas. He received a gold medal for his work. In 1875 he completed his course with an outstanding record and received the degree of Candidate of Natural Sciences.

The following four years were difficult ones for the young scientist. It was hard to find work since the universities were controlled, as a rule, by political appointees of the tsarist regime. Those interested in serving science rather than currying favor were persecuted and many were forced to leave the country to carry on their researches. Among such victims were Sechenov and Mechnikov. Pavlov was no exception. So for four years he moved from laboratory to laboratory.

But finally in 1879, after graduating at the Military Medical Academy with a gold medal award for his research, he won a two-year fellowship. About the same time he was invited by the famous clinician, S. P. Botkin, to work in the physiological laboratory at his clinics. Here Pavlov could devote all his time to research, which he did until 1890. He was, in fact if not in title, in charge of the laboratory, if a small bathhouse with no equipment and no funds to buy animals for experiments can be dignified with the title. But here in his first laboratory Pavlov was completely his own master and thus had full opportunity for creative development.

The Chronic Method

It was mainly in the Botkin clinics that Pavlov carried on his research into the nervous regulation of blood circulation. Here we are not primarily concerned with the results of these experiments, but we are interested in the new experimental method devised by Pavlov, for it was one component leading to the eventual discovery of conditioned reflexes.

Pavlov found that the classic physiological method of experimenting on anaesthetized animals was unsuitable for work on the complex problem of nerve regulation. Anaesthesia had a

distorting effect on the reflex actions of the nervous system. Pavlov succeeded in eliminating this and in taking a first step toward his method of studying the functions of the intact organism under natural conditions. He did this by training the experimental dogs to lie on the operating table and calmly undergo without narcosis all the manipulations of an elaborate and lengthy experiment: incising the skin and surface tissues; disclosing the artery and connecting it to instruments for registering blood pressure, and similar procedures.

By this new method Pavlov was able to discover a number of important laws concerning the reflex regulation of the cardiac and vascular functions. From these discoveries he made a broad generalization to the effect that not only the blood vessels, but all organs contain specific sensitive nerve devices adapted to respond to mechanical, physical or chemical stimulants. From this he concluded that it is the nervous system that regulates and combines the varied activity of the organism into one unified whole.

These broad generalizations were by no means speculative, but were the result of almost fifteen years of exacting yet creative experimental work. They were firmly rooted in what Pavlov throughout his life liked to refer to as "Mr. Fact."

In 1881 Pavlov had married Serafima Karchevskaya and they had experienced very hard times. So poor were they that at one point he had to live at the laboratory while Serafima lived with relatives. The lack of proper living conditions led to a miscarriage of one child and the death in childhood of another.

Finally in 1890 Pavlov was appointed Professor of Pharmacology at the Military Medical Academy, and for the first time had some measure of comfort and security. He remained for five years at this post, and then was appointed to the chair of physiology in the same academy, which he held for some thirty years. It was at the Military Medical Academy that he did some of his work on the digestive system and the early phase of the work on conditioned reflexes.

Meantime he had been invited, in 1891, to organize and direct the department of physiology in the new Institute of Experimental Medicine. He was head of that department for 45 years—until the end of his life. Here he did the bulk of his

classic experiments on the digestive glands which made him world famous.

The study of digestion was one of the backward branches of physiology. The chief reason was that the old "acute" or vivisectional type of experiment was not suitable for studying the intricate workings of the digestive glands. In overcoming this difficulty, Pavlov perfected his method of the chronic experiment, begun in his work on circulation.

The method was called "chronic," meaning lasting a long time or continuously, in opposition to the "acute," meaning short but critical, or coming speedily to a crisis through drastic surgery (for example, the removal of organs for purposes of analysis). This latter method had played an important role in physiological research as long as the analysis of *structure* was the primary task. But when the *function* of an organ or system of organs was to be investigated, the drastic acute method was far too crude and led to distortions of functions which made discovery of laws all but impossible.

The secret of the chronic method as employed by Pavlov was to treat the organism as a whole, thus making possible the investigation of the *interrelation* of organs. The technique employed was the construction, through highly skilled surgery, of a fistula, an opening or a "window." This fistula would then allow the experimenter to observe the functioning of the gland or organ or system under controlled conditions but without interference with the normal, healthy functioning of the animal.

Pavlov devised and performed a series of ingenious and delicate operations to construct these fistula "windows." He built fistulas in the stomachs, pancreas and salivary glands of his experimental animals. These made accessible for observation and experiment the internal digestive organs without impairing their nervous regulation, blood supply, and interconnection throughout the animal organism. They made it possible for the researcher to observe and experiment on an animal while at the same time it lived a normal life and its living conditions remained essentially unaltered.

Pavlov accomplished this feat by masterful surgical technique and by instituting for the first time in history the kind of aseptic operative and post-operative care which had up to that time

been the case only in hospitals for human beings. This was absolutely necessary if the experiment was to be chronic. The health of the animal had above all to be preserved or restored.

On such healthy animals with fistula "windows" in different parts of the digestive system, Pavlov carried forward his experiments to discover the facts and laws of digestion. This synthetic approach, the chronic method, made possible a much closer, and more detailed and all-sided study of the digestive glands as they function under normal life conditions without disturbing the integrity of the complex organism or its relation with the environment.

Here again we are not primarily concerned with the results of these experiments on the digestive glands. We are, however, deeply concerned with the innovation in method. For it was this method that was to make possible Pavlov's work with the conditioned reflex.

The acute type of experiment is mechanical in approach since it treats the organs and systems of the organism as parts of a simple machine which can be disassembled without changing their nature and function. At the same time, it isolates the organism from its environment. The acute experiment, as Pavlov put it, is unfit even "to obtain irreproachable analytical data," let alone synthetical. The analytical and synthetic methods, analysis and synthesis, both are essential for scientific experiment if it is to disclose the function as well as the structure of complex living matter. This is particularly true when the investigation concerns nervous regulation, since all nerves are coordinated through the central nervous system, and isolation cannot but disrupt and distort the complex interrelations.

Analysis means the separation of anything into its constituent parts. It is the resolving, dissecting, reducing of a thing from a single whole to its discrete elements. Such a process is an indispensable phase of any scientific inquiry. But it must be viewed as a *phase,* and not as an end in itself. For an organ is not simply a collection of parts, but is a system, a more or less complex interrelation of constituent elements. Not only that, but the organ is likewise, itself, not isolated from others which together form another system. Thus any system of parts forming a single organic whole is interrelated in two ways, internally

and externally; that is, the interconnection of internal parts and the interrelation of organism and environment.

The process of studying the interconnections and interrelations and of treating the organism as a whole, together with its life conditions, is called synthesis, or the synthetical method. Synthesis is the putting together, the composition, the combination of parts or elements to form a whole. As such, it is the direct opposite of analysis. The two in their interconnection form the methodology of science, if it is to discover the laws of complex processes.

Pavlov was the first physiologist to employ both approaches systematically. The chronic experiment was the solution of the problem of synthesis in physiological investigation. He supplemented the analytical approach to the structure and functions of the organism with a synthetic one. In this way he created a dialectical method of study; that is, he combined the two opposite methods into one unified approach. It was this dialectical method which enabled Pavlov to study the organism in its integrity and in its unity with its environment.

In his study of blood circulation and of digestion, Pavlov was governed by a single idea: to investigate the nervous regulation of the activity of the organism. This idea or principle he called "nervism." "By nervism," Pavlov wrote, "I mean the tendency in physiology which tries to extend the influence of the nervous system on the greatest possible number of functions of the organism."[3]

This principle was not entirely new with Pavlov, but had a brief history prior to his work. I. M. Sechenov, I. F. Tsyon, and S. P. Botkin played significant roles in developing it. It was Pavlov, however, who embodied nervism wholly in his work and who, with his later study of brain physiology, brought it to full fruition.

Under the theoretical guidance of the principle of nervism and employing the method of the chronic experiment with its fistula windows, Pavlov in his twenty-odd years of work on digestion proved conclusively that the main digestive glands, such as the liver, the gastric glands, and the pancreas, have nerves that cause the secretion of digestive juices. This was a major discovery, one which brought the study of digestion out

of the stagnation in which it had remained for decades.

Pavlov published in 1897 the results and generalizations of his study of digestion in a book entitled *Work of the Digestive Glands*. For this he was awarded the Nobel Prize in 1904. He was the first Russian scientist, and the first physiologist in the world, to receive the award.

Pavlov's Momentous Decision

By 1901 Pavlov had become engrossed in a problem of which he had been aware for some time during his work on the digestive glands, but had deferred investigating. This problem led him to the discovery of the conditioned reflex and to the study of the brain, the apex of the nervous system. The final thirty-five years of his life were devoted to this work.

In his work on the digestive glands, Pavlov and his research assistants had found that gastric juice was secreted by the experimental dogs not only when food was introduced into the mouth but also when they saw the food at a distance. Later on in his study of digestion, he ran across the same situation with regard to the secretion of saliva. This latter was, of course, nothing new. It was the familiar phenomenon of the mouth "watering" at the sight or scent of food. Pavlov called it "psychical stimulation" of the gastric and salivary glands. The term "psychical" was employed to distinguish action at a distance through the sense organs from the direct stimulation of nerve endings in the mouth.

Traditionally, investigation of the direct stimulation by contact in the mouth had been the province of physiology, while action at a distance had been considered within the jurisdiction of psychology. Pavlov had made significant contributions to the understanding of the nervous regulation of gastric and salivary secretion caused by the introduction of food into the mouth. But now he was confronted by a different phenomenon, one which was generally considered to be far beyond the reach of physiology.

Action at a distance through the eyes, ears and nose was interpreted in terms of judgment, will and desire, the so-called higher functions. To explain such action at a distance, psychol-

ogists of the period resorted to introspective interpretation of the subjective life of animals. It was said that animals "judged" that the scent was food and that they "desired" it.

Animal psychology, at the time, had not yet been put on an objective experimental basis and when Pavlov first ran across the phenomenon of "psychic stimulation," he, too, fell in with the introspective approach. Thus, in his book on the digestive glands, he says that "the excitation of the nerves of the gastric glands was due to a psychical factor which had assumed a physiological character," and continues with the statement that this was due to the fact that food ". . . must be acquired not only by muscular effort but also by the aid of higher functions—the animals' judgment, will and desires."[4] In short, he interpreted animal psychic stimulation in terms of the subjective life of man.

As his work on digestion proceeded, the psychic-stimulation of the gastric and salivary glands interfered with the experiments to such an extent that Pavlov could no longer ignore the phenomenon, nor could he brush it aside by relegating it to the realm of introspective psychology. He began to doubt his correctness in thinking of these phenomena from the introspective psychological point of view and he decided to investigate "psychical stimulation."

The question, as Pavlov saw it, was: How must the physiologist treat these psychical phenomena? He finally found the answer, but only after much thought and inner struggle: "After persistent deliberation, after a considerable mental conflict, I decided finally, in regard to the so-called psychical stimulation, to remain in the role of a pure physiologist, i.e., of an objective external observer and experimenter, having to do exclusively with external phenomena and their relations."[5]

We do not have to conjecture about the nature of the "deliberation" and "mental conflict" Pavlov went through to reach his decision, for it was not confined to his inner thoughts. There was a sharp struggle taking place in his laboratory.

One collaborator, Dr. Wolfson, went ahead and collected important facts on psychic stimulation. But Dr. Snarsky, up to that point a very competent research worker on the digestive glands, "undertook," says Pavlov, "to analyse the internal me-

chanism of the stimulation from the subjective point of view, i.e., he assumed that the internal world of the dog—the thoughts, feelings, and desires—is analogous to ours."[6] Here for the first time in Pavlov's laboratory there was a sharp split on a fundamental line of work.

Already at the turn of the century Pavlov was faced with a right angle fork in the road to a scientific animal psychology. On the one hand was the attempt to understand psychic phenomena by probing the "thoughts, desires, and feelings" of animals, the introspective method. On the other, was the attempt to understand animal behavior on the basis of external stimulation and underlying nervous processes through experiment, the objective method.

Of the two opposite paths, Pavlov wrote: "Generally speaking, there are two paths. First, the ordinary path along which everyone goes. Following this way, we must superimpose our inner world on the animal, thus assuming that he thinks, feels, wishes. etc., just about as we do. Consequently, we may guess what transpires within the dog, and thus try to understand his behavior. Or there is a second and entirely different path. Along this way we observe from the standpoint of a naturalist who looks on the phenomena, on the facts, in a purely external way, concentrating his attention only upon these questions: What agents of the external world act, and what are the visible reactions of the dog to these agents; what does he do?"[7] Pavlov poses the crucial question for the construction of a science of psychology: Which is the right way, the introspective or the objective path?

Dr. Snarsky took one path, Pavlov the other. But it was not an easy decision. For it meant coming into sharp conflict with commonly held beliefs and opinions. More, it involved a strong challenge to what in Russia at the time was official church-state doctrine on the nature of the soul.

The struggle between Snarsky and Pavlov was in fact a struggle between a scientist who was not willing to follow the facts wherever they led, and one who, even in the face of predictable official disapproval and oppression, put science above expedience and followed Mr. Fact wherever he ventured.

In a lecture in honor of Thomas Huxley, the popularizer

of Darwin, delivered in London in 1906, Pavlov tells the story of "a young doctor," obviously a reference to Snarsky, who, though capable of appreciating the joys and triumphs of scientific investigation, could not go along with an objective approach to the psyche. "Great was my astonishment," Pavlov says, "when this loyal friend of science became profoundly disturbed on hearing of our plans to investigate the psychical activity of the dog in that same laboratory and by the same means which we had been using for the solution of physiological questions. All of our arguments were ineffective; he prophesied and hoped for only failure." Why was Snarsky so opposed to this approach? Pavlov answers, "The cause of this, as far as we could understand, was his idea that the psychical life of man and that of the higher animals was so individual and exalted that it not only did not lend itself to investigation, but would even be sullied by our rude physiological methods."[8]

It was against such attitudes within his laboratory, and even within himself, reflecting the forces of uninformed public opinion, church and state, that Pavlov had to struggle before he could finally make his decision. But make his decision he did. "We chose," he says, "to maintain in our experiments with the so-called psychical phenomena a purely objective position. Above all, we endeavored to discipline our thoughts and our speech about these phenomena, and not to concern ourselves with the imaginary mental state of the animal; and we limited our task to exact observation and description of the effect on the secretion of the salivary glands of the object acting from a distance."[9]

Thus Pavlov made his decision and took his stand solidly with natural science. The general scientific principle on which he based his choice of paths for the investigation of psychical phenomena was that there must be no assumptions from sources other than nature itself. "This is natural science," he says, "the work of the human mind applied to nature, and the investigation of nature without any kind of assumption or explanation from sources other than nature itself. Were the investigator to speak of the psychical faculties of the higher animals, he would be transferring ideas from his own inner world to nature, repeating the procedure of his predecessors who were accustomed, on observing nature, to apply to its inanimate phenomena their

own thoughts, wishes, and sensations. The naturalist must consider only one thing: What is the relation of this or that external reaction of the animal to the phenomena of the external world?"[10]

The broader philosophical implication of the position taken by Pavlov is momentous. Primarily it is the rejection of the idealist assumption of the soul and the full acceptance of the materialist position that mental phenomena are rooted in material processes and therefore subject to experimental scientific investigation. In effect he is saying of the concept "soul" what LaPlace is reported to have said to Napoleon when the latter asked about the place of God in his view of the solar system: "Sir, I have no need of that hypothesis." Pavlov did, in fact, make a similar statement, not to Napoleon but to a scientific gathering in London: "For the naturalist everything is in the method, in the chances of attaining a steadfast, lasting truth, and solely from this point of view (obligatory for him) is the soul, as a naturalistic principle, not only unnecessary for him, but even injurious to his work, vainly limiting his courage and the depth of his analysis."[11]

Here, indeed, was a gauntlet thrown in the face of tradition. So conscious was Pavlov of the full significance of his decision that he returns to it, always in a fighting mood, over and over again in his *Lectures*—from the turn of the century to his death in 1936. Perhaps the finest of these challenging statements was made in one of the first lectures he gave on the subject, at the International Congress of Medicine in Madrid in 1903. Here he clearly indicates that he includes human psychic activity within the ultimate scope of the objective scientific approach: "Only by proceeding along the path of objective investigation can we step by step arrive at the complete analysis of that infinite adaptability in every direction which constitutes life on this earth. . . .

"We can analyse adaptability in its simplest form by use of objective facts. What reason is there to change this method in studying adaptability in the higher orders! . . .

"Guided by the similarity or identity of the external manifestations, science will sooner or later bring the obtained objective results to our subjective world, and will at once illuminate our

mysterious nature, will explain the mechanism and the vital meaning of that which eternally occupies the human mind—its conscience and its tribulations."[12]

What were the influential forces at work on Pavlov to bring him to the decision to investigate psychic activity by the objective method of science? There were, of course, many factors. There was his long experience as a most successful experimental scientist, in the fields of blood circulation and digestion. Further, his career thus far in work on the lower nervous functions had prepared him for investigation of higher nervous functions. The nervous system was his burning concern and interest. Also, no doubt, the fact that brain physiology was in a blind alley, as much as circulation of the blood and digestion had been, posed an irresistible challenge to him. At work, too, in all likelihood, was the situation in psychology, not yet a science, and, as far as he could see, off entirely on the wrong scent. Closely linked with this was the use of this speculative and introspective discipline for reactionary purposes in tsarist Russia and elsewhere—the mystery of the soul and the doctrine of eternal human nature, forever unchanging. In a scientist imbued with the scientific and democratic spirit of men like Dobruilibov, Lomonosov, Sechenov, Mechnikov, Timiryazev, and Michurin, it was natural to face a challenge with courage and singleness of purpose.

But perhaps the single most important influence was his familiarity with the works of I. M. Sechenov, and more especially *The Reflexes of the Brain.* Here, in this man and this book, Pavlov had not only an example of courage in the face of persecution, but a treatment of the same subject, speculative rather than experimental to be sure, but full of scientific insights and important ground-breaking for a physiology of the brain.

That Sechenov and his work played a major role in Pavlov's decision is attested to by Pavlov himself: "And I take it that the most important motive for my decision, even though an unconscious one, arose out of the impression made upon me during my youth by the monograph of I. M. Sechenov, the father of Russian physiology, entitled *Reflexes of the Brain* and published in 1863. . . . In this book, a brilliant attempt was made, altogether extraordinary for that time (of course, only theo-

retically, as a physiological outline), to represent our subjective world from the standpoint of pure physiology."[13]

To understand more fully Pavlov's decision and to get an appreciation of the work that led to Pavlov's discoveries about the higher nervous functions, we introduce the reader briefly to the life and works of I. M. Sechenov.[14]

I. M. Sechenov

Ivan Michailovich Sechenov was born on August 1, 1829, on his father's estate in the Middle-Volga district. He was instructed in foreign languages by a governess and in arithmetic and Russian by the parish priest. He was trained in the Military Engineering School in St. Petersburg and spent a year and a half in the army. During this time he became intensely interested in science and medicine, and, on leaving military service he matriculated in the Medical faculty of Moscow University. After taking his M.D. degree in June 1856, he studied abroad, together with S. P. Botkin, the future teacher of Pavlov, under such world-renowned scientists as DuBois Raymond and Claude Bernard in France, Johannes Müller, Carl Ludwig and Herman von Helmholtz in Germany. He spent considerable time travelling in the company of his friends Mendeleyev and Borodin (the famous chemist and the composer of Prince Igor).

On returning to Russia in 1860, he was appointed Assistant Professor of Physiology in the Medico-Surgical Academy and began a series of lectures on physiology which produced an immense impression on the academic world and intellectual society generally. He was the first to bring to Russia the teachings of Bernard, Ludwig, Müller and Helmholtz.

In 1862, Sechenov again went to Paris where, in Claude Bernard's laboratory, he carried out an experimental investigation of the nervous centers which inhibit reflex movements. After he returned to Moscow he wrote a treatise based on these experiments, which he intended to publish in *Contemporary,* a widely read monthly review. The title of the piece was to be *An Attempt to Establish the Physiological Basis of Psychical Processes.* But the tsarist censor would only permit the publication

of the treatise in some special medical journal and ordered that the title be changed on the ground that it showed "too clearly the conclusion aimed at by the treatise." It was accordingly published in a medical journal in 1863 under the title *Reflexes of the Brain.*

The original title does, indeed, show clearly the aim of the treatise. At the very outset Sechenov states that he has decided "to communicate to the world some ideas concerning the psychical activity of the brain—ideas which have never been expounded in the literature of physiology."[15]

To establish "the physiological basis of psychic activity," he had to challenge head-on the long tradition, stemming from Descartes' psycho-physiological parallelism—the doctrine that body and mind comprise two completely separate and materially unrelated systems which somehow run on parallel tracks. For the purpose of this challenge Sechenov based himself on Locke and Darwin. The former taught the dependence of psychic activity on sense experience, and the latter that all phenomena have a history including origin and development from lower forms. More immediately, he based his thinking on the physiology of the reflex developed by many scientists, including Claude Bernard.

What he was setting out to demonstrate was the revolutionary idea that the soul, the psyche, far from being independent of the body, is in fact a function of the central nervous system in general and the brain in particular. It was, therefore, a daring materialist challenge to a deeply entrenched doctrine. And it was presented just four years following the publication of Darwin's *Origin of Species* in 1859.

Sechenov develops his argument around the nature of the reflex. A reflex always has a three-phase structure: first the stimulation from the external (or internal) environment of the sense receptors (skin, eye, ear, nose, etc.); second, the transmission to the spinal cord or to the brain where further connections and interconnections are made; and third, the transmission outward again, but this time not to the sense receptors but to the muscles leading to activity. This structure was well known with regard to lower animals. Much of the experimental work had been carried out on frogs through vivisection. In this way excitation and

inhibition had been analyzed as the chief elements in nervous processes. Sechenov, himself, had published two papers on the mechanism of inhibition in the brain of frogs.[16]

Sechenov's thesis is that all the immense diversity of psychical phenomena can and must be explained on the basis of the nervous system and the brain, and that there is no reason to presume that higher nervous activity proceeds in any other way than through the mechanism of the reflex arc which is the mode of operation of nervous processes generally.

He begins by stating the essential materialist principle that "the brain is an organ of the spirit, i.e., a mechanism which, when brought into activity by any kind of cause, produces as a final result that series of external phenomena which we characterize as psychical activity." This psychical world is so vast, its manifestations so varied, its complexities so intricate that, as Sechenov puts it, the task of finding a physiological basis "at first glance, appears to be impossible." But, he adds, "in reality it is not so, and for the following reason."[17]

The reason is that underlying all the endless diversity of psychical phenomena there is a single unifying feature. They are all expressed in muscular activity, whether in words, spoken or written, or in deeds. He speaks of a child laughing at the sight of toys, Garibaldi smiling when he is persecuted for excessive love of his fatherland, a girl trembling at the first thought of love, or Newton enunciating universal laws and writing them on paper, "everywhere the final manifestation is muscular movement. To show this thought is not as startling as it might at first appear, Sechenov reminds the reader that mankind down the ages has created the framework of knowing the psychic or spiritual activity of a person by his word and deed. "Under *deed*" says Sechenov, "the popular mind conceives, without question, every external mechanical activity of man based exclusively on the use of muscles. And under *word,* as the educated reader will realize, is understood a certain combination of sounds produced in the larynx and the cavity of the mouth, again by means of muscular movements."[18]

By starting with what people already accept, Sechenov has begun the demonstration of his thesis that the reflex is the mechanism of the brain and therefore the physiological basis

of psychic activity. Muscular activity is, however, the third phase of the reflex arc. Thus one-third of his task is completed. He goes on to demonstrate in great detail for many pages that both involuntary and voluntary muscular activity are the end result of a reflex arc stemming from the spinal cord or the brain.

His next job is to show that all reflex arcs have their initial phase in the stimulation of sense receptors, and that the activity of the brain is no exception.

Here Sechenov appeals to Locke as well as to experimental evidence from lower forms of nervous activity. Locke's position, essential to his empirical philosophy in the bourgeois revolutionary struggle against the feudal concept of innate ideas implanted by god or nature, was that all ideas are complex combinations of simple ones which originate in sense experience, via eyes, ears, and nose. Hence, there is no mental activity without sense stimuli. Without sensory stimulation there is no thought or emotion.

It had been already well established that no reflex in the lower orders of animal life is possible without sensory stimulation from the environment. Putting the two sources of evidence together, Sechenov concludes that psychic activity as a function of the brain by means of reflexes can only be initiated by some stimulation of one or more of the senses.

Now he has "demonstrated" that the activity of the brain in higher animals, including man, has two of the features of the reflex: its initiation in sense stimulation and its culmination in muscular activity. Two-thirds of his job is done.

But what about the final third? Can what happens after sense stimulation and prior to muscular activity be accounted for in terms of the second phase of the reflex, i.e., the connections and interconnections made within the brain? The question is whether thought and emotion can be accounted for in terms of reflex.

Sechenov answers in the affirmative. But here he is on less firm ground for he has only analogy to go on, analogy with lower forms. But his hypothesis was brilliant for the time. Later it was to be revised and given experimental proof in its main outline by Pavlov with the discovery of conditioned reflexes.

Sechenov postulated certain centers within the human brain the function of which were to augment or inhibit the third, or

muscular, phase of the reflex arc. Emotions he accounted for in terms of an augmented muscular response, and thought by an inhibited muscular response.

To buttress his contention that thought is the result of inhibited muscular response, he cites two types of phenomena as evidence. First, he recalls that children through admonition, punishment and reward learn to inhibit certain actions. Adults, likewise, learn to inhibit the expression of their feelings and certain forms of behavior. Second, the fact of inhibition of reflex responses had been proven in the case of frogs and other lower forms. From the latter he concludes that the existence of similar mechanisms in man must be accepted as a logical necessity.

By inhibiting muscular activity, the final phase of a reflex, man learns to think before he acts. A thought is thus the first two-thirds of a reflex, sensory stimulation and connections in the brain, while motor reaction is inhibited. "In a thought," Sechenov says, "we have both the beginning of a reflex, and its continuation; only the end of the reflex (i.e., the movement) is apparently absent."[19]

In an emotion, on the other hand, all three elements of a reflex are present, but the end, the muscular response, is augmented. This means that the muscular activity or expression is stepped up beyond the usual response to the given stimulus.

In a similar manner, Sechenov attempts to account for all the psychic phenomena, e.g., sensation, perception, will, wish, desire, memory, imagination, the love of man for woman, child development, etc., within the framework of the reflex arc with its three phases. In each and every case, he is primarily concerned with showing that *"the real cause of every human activity lies outside man,"* namely, in external sensory stimulation and in external muscular motion. This was his primary task, for in developing these two hypotheses he is establishing at least two-thirds of the proposition that all psychic phenomena are of the nature of a reflex. As for his speculation about inhibition and augmentation, he, himself, says, "This is a matter of secondary importance."

He concludes, "My chief task is to show that all acts of conscious and unconscious life are reflex from the point of view

of their mechanism" and "to show the psychologists that it is possible to apply physiological knowledge to the phenomena of psychical life, and I believe that my aim has been partly attained."[20]

In the final sentence of *Reflexes of the Brain,* Sechenov flings a challenge to all comers: "Now let anyone try to assert that psychical activity and its expression, movement, take place without external sensory stimulation!"[21]

The ideas presented in *Reflexes of the Brain* were so novel, so daring, and so convincing that the book rapidly became known all over Russia. It immediately became part of that heritage of realism and materialism in the sciences of which the Russian and now the Soviet peoples are so justly proud.

But official circles frowned on this great materialist document. The persecution, begun before publication, reached its climax in 1866 when *Reflexes of the Brain* appeared in book form. The sale of the book was forbidden by the Petersburg Censorial Committee. This same committee summoned the Attorney-General to institute an action against Professor I. M. Sechenov's "extreme materialist" book on the grounds that "it undermines the moral foundations of society and thereby destroys the religious doctrine of eternal life. . . . Mr. Sechenov has given his theory the form of a scientific treatise; but its style is far from scientific, it is written so as to be easily understood by the layman. This fact and the low price of the book (80 kopeks) prove that the author's intention is to make his theory accessible to a wide circle of readers. It follows that Mr. Sechenov's book *The Reflexes of the Brain* is directed to the corruption of morals; it is indictable as dangerous reading for people without established convictions, and as such must be confiscated and destroyed under article 1001 of the Penal Code."

The Attorney-General refused to take action against the professor since he did not explicitly deny the immortality of the soul. "Consequently," he held, "Sechenov's teaching, if it is erroneous, must be dealt with by means of scientific discussion, and not by means of legal procedure in the Criminal Court." But the decision was not the product of good will on the part of the Attorney-General. It was the popularity and fame of the book which deterred prosecution. This is clear from a letter written

at the time by the responsible official: "To explain in a popular book, even from the physical point of view, all the inner activities of man as reflex actions due to the influence of external agents upon our brain—is not this an attempt to substitute a new doctrine which recognizes the existence only of the material side of man for the doctrine of the immortality of the Soul?"[22] Thus, his decision was based not on what he believed to be true, but on expediency in the light of popular opinion.

Sechenov lived for forty-two years after the publication of *Reflexes of The Brain.* Much of that time was passed as Professor of Physiology at Moscow University. He also taught without pay several courses at the Women's Pedagogical Society and at a school for factory workers. Both these teaching tasks were part of his life-long struggle for extending education in tsarist Russia to women and to workers. These years were rich in scientific work, lecturing, and publishing papers in the professional journals. Through his laboratory work and his teaching he won for himself the unofficial title of father of Russian physiology.

One of his papers, written around 1875, is of special interest for us. It was published under the provocative title, *Who Must Investigate the Problems of Psychology and How.*[23] Obviously, his answer to the titular question is that the physiologist must investigate the problems of psychology by objective experimental methods designed to reveal the reflex structure and function of higher nervous processes. Thus, the article follows the main line of his earlier treatise.

But he includes a sharp indictment of the introspective method which he calls, scoffingly, "self-observation," and charges that by this approach psychologists merely invent *forces* to explain the psychical phenomena they observe in themselves. "It turns out," he says, "that the educated man explains the various aspects of psychical phenomena in exactly the same way as a savage explains those natural phenomena which he does not understand. The only difference is that the imaginary agencies postulated by the educated man are *forces,* while those postulated by the savage are spirits." He even seems to anticipate certain current schools when he adds: "Finally, there are cases when the thinker, in a boundless frenzy of mental speculation, endows some innocent grammatical form with all the properties

of psychological reality; take, for instance, that widespread and naive quibble—the conception of the 'ego.' "[24]

Opposed to this introspective "frenzy of mental speculation," Sechenov states that "The general character of the problems of psychology, as determined by our principle, is that psychology limit her research to the question of *how* a given psychical process (manifested in an emotion, feeling, image, voluntary or in- should follow the example of her sister science, physiology, and voluntary movement, etc. or leading to a thought) takes place."

The question of how psychical processes take place "is the business of physiology," for it has to do with the "study of all sides of *entire* reflex acts, including their beginning, middle and end."[25]

Then there follows a summation of Sechenov's thinking on the question of how psychology, with the aid of physiology, is finally to become an exact, positive science, based not on introspection but on objective experimentation: "Strictly adhering to the principle of induction, physiology will begin with a detailed study of the more simple aspects of psychical life and will not rush at once into the sphere of the highest psychological phenomena. Its progress will therefore lose in rapidity, but it will gain in reliability. As an experimental science, physiology will not raise to the rank of incontrovertible truth anything that cannot be confirmed by exact experiments; this will draw a sharp line between hypotheses and positive knowledge. Psychology will thereby lose its brilliant universal theories; there will appear tremendous gaps in its supply of scientific data; many explanations will give place to a laconic 'we do not know.' . . . And yet, psychology will gain enormously, for it will be based on scientifically verifiable facts instead of the deceptive suggestions of the voice of our consciousness. Its generalizations and conclusions will be limited to actually existing analysis; they will not be subject to the influence of the personal preferences of the investigator which have so often led psychology to absurd transcendentalism, and they will thereby become really objective scientific hypotheses. The subjective, the arbitrary and the fantastic will give way to a nearer or more remote approach to truth. In a word, *psychology will become a positive science.*"[56] Indeed, it is clear what a profound influence these writings of the father of Russian physiology must have had on the discoverer of the conditioned reflex.

In 1915, on the tenth anniversary of the death of Sechenov, Pavlov, unable to attend, sent a telegram to a session of the Moscow Scientific Institute commemorating the event: "Unable to be present personally, I permit myself to take part in the Assembly at least by cable. Sechenov's teaching on the reflexes of the brain is, in my opinion, a sublime achievement of Russian science. The application of the reflex principle to explain the activity of the higher nervous centers is a proof that causality can be applied to the study of the highest forms of organic nature. For this reason the name of Sechenov will forever remain dear to the Russian scientific world."[27]

Thirty-Five Years of Work on Conditioned Reflexes

The writings of Sechenov and the example of his fortitude in the face of persecution were decisive factors in Pavlov's determination to pursue the facts and laws of psychic phenomena. The *Reflexes of the Brain* gave him at once both the clue and the essential problem with regard to the unravelling of the intricacies of higher nervous processes.

The *clue* lay in the thesis that psychic activity must be regarded, not as a function of consciousness or of the brain alone, but as including the three-thirds of a reflex, namely (1) sensory stimulation, (2) the brain, and (3) muscular activity in the form of behavior, deeds and words. As long as psychology restricted itself to the middle phase or third alone (consciousness), then it could rely only on introspection. For in that case there was no external cause (sensory stimulation) or external effect (muscular activity). From Sechenov, Pavlov learned that the clue to the study of higher nervous activity was the reflex in all three of its phases. This made objective analysis possible, since sensory stimulation and muscular activity are observable and therefore subject to experimentation. Consciousness need no longer be probed by introspection, for it is externally manifest. This was a brilliant and creative clue.

The *problem* set for Pavlov by Sechenov was to establish what is the function of the brain as the middle phase of a psychic reflex. Sechenov had conjectured about this role in terms of centers for inhibition and augmented response. But Pavlov, through

his chronic experimental method, was able to establish that the brain with its cerebral cortex is the seat of what he called conditioned reflexes. These conditioned reflexes constitute the mechanism of psychic activity. This means that the cerebral cortex, as the center of conditioned reflexes, allows the higher animals to make subtle and detailed adaptation to their environment *during the lifetime of the individual organism.* It is a great leap forward in the adaptability of animals to the world around them.

Thus Pavlov, working with the clue furnished by Sechenov, was able, through his great technique of the chronic experiment, to solve the problem bequeathed to him by the author of *Reflexes of the Brain.* The discovery of the conditioned reflex opened possibilities for a new approach in the human sciences, physiology, medicine, psychology, psychiatry, child development, and education.

Pavlov worked on the discovery and elaboration of the conditioned reflex for thirty-five years. His research progressed from dogs to human beings in psychiatric wards. The result of this work will be dealt with in the following chapters.

Although Pavlov's financial difficulties eased during his last thirty-five years, especially after his appointment to professorships at the Institute of Experimental Medicine and the Military Medical Academy, his conditions of scientific work and the attitude of tsarist officials toward it remained exceedingly unfavorable. He had great difficulty in obtaining collaborators; in fact, there were no more than five or six in all the laboratories under his guidance. He had to pay out of his own pocket the salary of his assistant in the laboratory of the Imperial Academy of Sciences. This difficulty with regard to collaborators was due, among other things, to the hostility toward him of the Minister of War and the chiefs of the institutions. They hated him for his democratic views, his never-ending struggle against the despotism of tsarist officials, his support of student causes, and finally and most important, because of his materialist and objective approach to psychic phenomena. In this persecution, Pavlov was by no means alone. All true scientists were subjected to it in tsarist Russia: Mendeleyev, Sechenov, Mechnikov, Timiryazov, Michurin, and the whole host of less well known scientific workers.

But Pavlov was one of the few great pre-Revolutionary Rus-

sian scientists who lived on into the era of socialism. In the last nineteen years of his life the conditions for his work took a decided turn for the better. Even in the early days of the revolution when the young Soviet State was fighting for its very existence, Lenin issued a special government decree noting the "outstanding scientific contribution of Academician I. P. Pavlov, which are of enormous significance to the working class of the whole world." A commission headed by Maxim Gorky was organized "to create in the shortest time the most favorable conditions for the scientific work of Academician Pavlov and his collaborators." The appropriate government departments were "to publish in a de luxe edition the scientific work prepared by Academician Pavlov . . . to furnish Academician Pavlov and his wife with a special ration and supply his laboratory and apartment with the maximum accommodations."[28]

As the Soviet Government and people consolidated their power and developed the economic resources of the country, Pavlov was given the most favorable possible conditions for his work. The laboratory building, known as the "tower of science," begun by private subscription before the Revolution, was completed. His seventy-fifth birthday was celebrated by the establishment of a new physiological institute, bearing his name, in the Academy of Sciences of the U.S.S.R. His eightieth birthday was honored by the construction of a "City of Science" in the village of Koltushi near Leningrad. His permanent staff increased many fold, some three hundred trained personnel working under him, and he received considerable sums above the budgetary allotments to be spent at his own discretion. Thus Pavlov received the full material and moral support of the Soviet Government, in sharp contrast to his treatment at the hands of the tsarist state.

In 1935, on his eighty-fifth birthday, Pavlov received the following greeting: "To Academician I. P. Pavlov: On your eighty-fifth birthday the Council of Peoples' Commissars of the U.S.S.R. sends you its warm greetings and congratulations. The government especially notes your inexhaustible energy in scientific work, the successes of which have deservedly placed your name among the classics of natural science. The government wishes you health, vigor and long years of fruitful work for the benefit of our great country."[29]

In the years immediately following the Revolution, Pavlov was critical of the changes taking place in Russia. But in 1935 his attitude had changed to such an extent that, in a speech at a banquet on the occasion of a visit to his birthplace, Ryazan, he said, "In our country the whole population honors science. . . . I would not be mistaken, I think, in saying that this is to the credit of the government at the helm of my country. Formerly science was divorced from the people, but now I see it otherwise. . . . I see that the whole nation respects and appreciates science. I raise my glass and drink to the only government in the world which could bring this about, which values science so highly and supports it so fervently—to the government of my country."

To the assembled delegates to the XV International Physiological Congress held in Leningrad and Moscow in 1935, he said: "As you know, I am an experimenter from head to foot. . . . Our government is also an experimenter, only on an incomparably higher plane. I passionately desire to live in order to see the victorious completion of this historical social experiment."[30] At this same congress, held as Hitler was rearming Nazi Germany and screaming threats of war against the Soviet Union, Pavlov, aware of the evils of fascism, said: "In a war we shall be defending our true fatherland, our culture, our science. The whole people will rise to defend their country."[31]

On February, 27, 1936, Pavlov died. The entire scientific world mourned his death. Many outstanding American scientists joined Maxim Gorky, H. G. Wells, and other world renowned intellectuals in eulogies of the great Russian physiologist, Walter B. Cannon, Harvey Cushing, and Robert Yerkes among them.

In the years since Pavlov's death, his work has been carried forward primarily in the Soviet Union. At a special joint session of the Academy of Sciences and Academy of Medical Sciences of the U.S.S.R., on the Physiological Teachings of I. P. Pavlov, held in Moscow in 1950, hundreds of physiologists, doctors, psychologists, and psychiatrists passed a final resolution which included the following statement:

"The session notes with deep satisfaction that Pavlov's ideas have completely triumphed in Soviet science.

"Pavlov's outstanding scientific achievements in establishing

that all forms of vital activity of the complex organism, including mental activity, are determined by its conditions of existence, have advanced our Soviet physiology to the foremost place in the world and opened up broad prospects for its further advancement. They have created a firm natural-scientific foundation for the reconstruction of medicine and psychology on scientific lines. . . . Pavlov's discoveries in the realm of the higher nervous activity, which are supreme achievements in the modern science of the brain, constitute a mighty natural-scientific foundation of the materialist world outlook, and a formidable weapon in our ideological struggle against all manifestations of idealism and obscurantism."

At the same conference, Professor A. G. Ivanov-Smolensky told the assembled scientists: "The higher nervous processes, which form the basis of psychological concepts—processes which until recently were entirely unamenable to study—now become the subject of objective investigation by a new science, the science founded by I. M. Sechenov and built up by I. P. Pavlov and his school."

The importance attached in the Soviet Union to the science of higher nervous activity is demonstrated in K. M. Bykov's report to the conference when he says that all physiology can be divided into two stages—"the pre-Pavlov stage and the Pavlov stage"—and adds, "The history of psychology may be divided in a similar manner. The pre-Pavlov psychology is based on the idealist outlook; Pavlov's psychology is essentially materialistic."[32]

The key principle in the Pavlovian physiology and psychology is the unity and integrity of the organism as a whole, together with the adaptation of the organism to the conditions of the environment and the environment to the requirements of the organism. In both aspects, the unity and the adaptation, the central role is played by the nervous system, and, in higher animals including man, the role of the cerebral cortex, as the seat of temporary or conditioned reflexes, is decisive.

Thus the conditioned reflex, as the prime organizer and regulator in the unity of the organism and in the adaptation to the environment, is the basic concept in the teaching of I. P. Pavlov.

What, then, is the conditioned reflex?

Chapter III

THE CONDITIONED REFLEX

FOR THIRTY-FIVE YEARS, dating from the threshold of the twentieth century, Pavlov devoted his energy to what he called "the investigation of the physiology of the cerebral hemispheres by the strictly objective method of conditioned reflexes." The result was the materialist conception of the higher nervous activity, his crowning achievement and one of the greatest feats in all the history of science.

At the turn of the century the physiology of the cerebral hemispheres was at a standstill, in both theory and method. It had already been established early in the nineteenth century that mental activity is a function of the higher parts of the central nervous system. But, apart from Sechenov's bold hypothesis that in the three phases of the reflex mechanism physiology held the key to the mysteries of psychic phenomena, little progress had been made for several decades. A leading German physiologist, F. Vagus Goltz, wrote in 1884, after thirty years of effort on his own part, "Anyone who has been engaged in fundamentally studying the physiology of the cerebrum will agree with me that we have little more indubitable knowledge of the processes occurring in this primary organ than we have of Mars."[1]

There seemed to be no way of experimentally investigating cerebral processes. The crisis was one both of theory and method. Thus in 1904 Pavlov wrote that the physiology of the cerebrum had made no progress for thirty years and attributed it to the fact that "the guiding ideas, the fundamental methods had been exhausted in the 70's—all is marking time within the old framework."[2]

In a famous and often quoted statement, he called this situation *the critical moment of natural science.* "One can truly say,"

he wrote, "that the irresistible progress of natural science since the time of Galileo has halted perceptibly for the first time before the study of the higher parts of the brain, the organ of the most complicated relations of the animal to the external world. And it seems, and not without reason, that now is the really critical moment for natural science; for the brain, in its highest complexity—the human brain—which created and creates natural science, itself becomes the object of this science."[3]

Here it is significant to note that this hiatus in the progress of brain physiology coincided with the rise of psychology as an independent discipline. The coincidence was important for it meant that psychologists were free to construct ingenious theories to account for psychic phenomena without being "impeded" by scientific experimental facts and laws. It was during this period of frustration of science before the complexities of the higher nervous processes that, among others, William James and Sigmund Freud built their psychological systems on the foundations of inborn instincts, drives and psychical forces. As long as the progress of science was blocked, there was not much to contradict such speculations.

Such a state of affairs in brain physiology and in psychology throws into sharp relief Pavlov's scientific feat. He brought the field of higher nervous processes out of its blind alley and at the same time furnished a sound basis for a science of psychology. He put both fields on the broad highway of progress.

As has been indicated, he started from the common, everyday fact that the mouth "waters" at the sight, at the mention, or even at the thought of food when we are hungry. He had run across the same phenomena in his experiments on the digestive system of dogs, in the form of what he called psychic stimulation of the salivary and digestive glands. In these experiments he was confronted with certain facts for which there was no satisfactory theoretical explanation. The only existing "theory" was based on an analogy to human subjective experience. What were the facts which led Pavlov to seek an objective explanation of psychic phenomena?

In his physiological experiments on digestion, he had analysed the reaction of the salivary and digestive glands to various types of matter introduced into the mouth of dogs. The results had impressed him with the fine adaptation of the work of these

glands to sundry elements in the environment. For example, if pebbles are put into a dog's mouth, there is no secretion of either watery saliva or mucous saliva. Watery saliva is necessary to swallow food, and saliva rich in mucin makes easier the passage of the food through the esophagus. But pebbles are not food, and must be ejected from the mouth. For this function, however, no saliva or mucin is necessary. And none flows. But introduce sand into the dog's mouth and there will be an abundant flow of saliva but little or no mucin. Here again there is a close adaptation, for to eject sand much watery saliva is required, but no mucin since the sand is not to be swallowed.

In theological explanations, such phenomena are, of course, considered as scientific proof of an all-knowing, all planning divine power. The facts would be explained teleologically, as elements of a great architectural plan in which *purpose* plays a decisive role. But science has a different explanation. Physiology knows, on the one hand, that there are centrifugal nerves to the salivary glands which can cause either water or mucin to pass into the saliva; and, on the other, that certain areas of the surface of the mouth act as receptors sensitive to different kinds of substances, mechanical, chemical, and thermal, and even for subdivisions of these such as in the chemical, salts, acids, etc. When pebbles are introduced into the mouth they act on none of these areas, whereas sand acts on the mechanical area and sets in motion a particular response, i.e., the introduction of water into the saliva.

Further, these nerves and receptor areas, according to the general Darwinian theory of evolution, were evolved through the ages by developing within a certain environment to which they adapted. Interaction of organism and environment, rather than so-called divine planning or innate intelligence, accounts for adaptation.

All these reactions of adaptation depend for their mechanism on a simple reflex having its beginning in certain external conditions which affect some specific area of the sense receptor. From there the excitation runs along a certain nerve path to the center where it is conducted to the salivary glands, calling forth their appropriate action. The function of these reflexes is to maintain for the organism an internal and external

equilibrium within the organism and between the organism and the environment.

It was while working on such phenomena in the study of digestion that Pavlov met with what he called "psychic" stimulation of the salivary and digestive glands. He found that all the substances which call forth specific secretions when in contact with the inner surface of the mouth, elicit the identical responses when they are at a distance from the dog. For example, the pebbles when shown to the dog have no effect on the glands, while sand provokes an abundant flow of watery saliva. The sight of dry food, even at a distance, produces much saliva, but moist food, only a little. "How," asked Pavlov, "should the physiologist treat such facts?"[4] It was in finding the answer to this question that he had to make the historic decision recounted in the previous chapter.

The first problem Pavlov faced was to discover in what way the psychic excitation is different from the physiological.

The obvious answer would seem to be that the difference lies in the fact that the physiological excitation is by direct contact while the psychical is action at a distance. But Pavlov reminds us how many simple reflexes start from action at a distance: from the nose (for example, sneezing), the eyes (blinking), and the ears (jumping). The difference between these phenomena is therefore not to be found here. It is necessary to seek more deeply.

He points out that in the physiological case the flow of saliva is connected with those properties of the substance being introduced into the mouth upon which the effect of the saliva is being directed. For example, the chemical properties of the meat itself, its texture, etc. Thus in the physiological experiments the dog is excited by, as Pavlov says, "the essential, unconditioned properties of the substance, *i.e.*, by those intimately connected with the physiologic role of the saliva."[5]

In the psychical experiment, on the other hand, the dog is excited by properties of the external object which are in no way essential for the work of the salivary glands: color, size, shape, scent, sound, etc. Further, the saliva of the dog may be provoked by stimuli completely different from the properties of the substance, for example, sounds, scents and sights or things

in the surrounding area. Thus the sight of the feeding dish, the footstep of the person who feeds, may call forth the dog's saliva. Not only the sight, sound and scent of the feeding objects themselves elicit a flow of saliva, but, as Pavlov says, "absolutely all the surroundings in which these objects are presented to the dog, or the circumstances with which they are connected in real life."

Thus in the psychical stimulations the connection of the objects exciting the flow of saliva becomes more and more distant and delicate. Not only the accidental properties of the food, but essential or unessential properties of other things in the immediate surroundings call forth the same secretion of saliva. "Undoubtedly," says Pavlov, "we have before us here an extreme degree of adaptation."[6] An animal, for example, a deer, can react to a hunter before the threat to its life is imminent, by reacting to *signs* such as scents, sights, and sounds, and even to more remote signs such as the scurrying of other animals, tracks, etc. The hunter knows only too well how excitable deer are to the most varied range of signs. In fact, the art of hunting is, in popular language, to "outwit" the deer, which means in large part to eliminate all possible signs of the hunter's presence.

The farmer, too, for thousands of years has known and made practical use of the psychic stimulation of cows, sheep, horses, pigs and other livestock. He always calls the same call, or makes some accustomed sound when he is going to feed domestic animals. In this way, if they are out in the pasture, they will come running and the farmer will not have to spend long hours in search and rounding up.

Animal training is another and even more complex example of the practical use of psychic stimulation. Hunting, animal husbandry and training "have borne witness," says Pavlov, "for a long time to psychical manifestations in animals." And he adds that "It is to be regretted that science has so long overlooked these facts." The divorce of science from production in real life has tended to check scientific progress, particularly in the fields of biology, physiology and psychology.

The importance of the remote signs or signals to the survival of animals is readily apparent. Without this capacity to react to distant and accidental properties of objects, there would be

no higher species of animals. "By means," says Pavlov, "of distant and even accidental characteristics of objects the animal seeks his food, avoids enemies, etc." The psychic reactions are, indeed, a primary means of adaptation of animals to the environmental conditions.

The trouble is that in psychic stimulation anything at all may become connected to a basic response so that there is an almost endless welter of complex relations. But it is precisely this feature which is most characteristic of psychic phenomena. It is the first difference between psychical and physiological experiments, for in the latter the introduction of a given substance into the mouth always excites the same response, while the main feature of the psychical experiment is the inconstancy of its results and its apparent capriciousness.

The problem Pavlov now faced was, "Can all this seeming chaos of relations be included in a certain scheme? Is it possible to make the phenomena constant, to discover laws which govern their mechanism."[7]

To disclose the unifying scheme and to discover the laws of psychic phenomena, Pavlov employed the method of the chronic experiment, using the technique of the fistula or "window."

He selected the salivary glands as the simplest in function and the most readily observable by means of a salivary fistula in the side of the mouth. A test tube attached to the fistula allowed exact measurements of the quantity of saliva secreted, and, at the same time, qualitative analysis of its composition. The salivary glands, however, are only relatively simple, for their function is not limited to the elementary "mouth-watering." Saliva is used also by the animal to lick and promote healing of its wounds and the various uses of saliva involve different varieties of it. Thus the functions of the salivary gland, though relatively simple, are nonetheless complex, and can tell a great deal about psychic phenomena.

Principal Facts and Laws of Conditioned Reflexes

By means of the chronic experiment using the salivary fistula, Pavlov was able to give a positive "yes" to the question as to whether systematic order could be brought out of the apparent

chaotic profusion of "psychic" stimulation. He was able to isolate stimuli and regulate their intensity. In this way he was able to amass a great number of carefully verified facts from which he could, through analyzing their interrelations, make generalizations about the specific mechanisms.

The first set of facts demonstrated an absolute condition for work with the salivary glands. An animal which is to be stimulated by food from a distance must be "hungry," that is, must have been prepared for the food stimulus by a previous period of fasting. An animal will not respond to psychic stimulation of the salivary glands unless it has an empty stomach. The generalization from this set of facts leads to a further, but hypothetical, generalization: that all psychic stimulations require a certain internal condition of the organism in order to permit the setting in motion of the given response. This hypothesis was later confirmed by hundreds of experiments and observations. The phenomenon of internal "readiness" for stimulation, or state of excitability, without which there is no excitation or response, is in itself an important adaptation to environmental conditions. For it relieves the animal from constant stimulation by food objects, for example, and leaves it free to react to other things including defense and sex stimuli.

A second set of experimentally verified facts established that if dogs are simply shown food, and this is repeated several times, at each repetition the resulting flow of saliva is weaker until there is no reaction at all. But the moment a bit of food is put in the dog's mouth, the full reaction of the salivary glands to the sight of food is restored. The adaptive function again is present since it causes the animal to cease reacting to stimuli which do not lead to concrete results, *e.g.*, food, and at the same time to have the capacity to regain response to such stimuli if they do bring results. The mechanism underlying these phenomena is that reaction to secondary properties or accidental conditions is based on a primary reflex to essential properties.

A third set of facts revealed that if a dog is shown dry bread, which evokes a profuse flow of saliva, and at the same time is shown moist meat, which evokes very little or no saliva, then the result of these two opposite stimuli will depend solely on which stimulates the dog more strongly. The moist meat is usually

stronger, and therefore the corresponding result is produced: there is no flow of saliva. The dry bread, which by itself would invariably call forth a lavish flow of saliva, remains completely without effect, even though lying before the eyes of the dog. Here again is an important feature of adaptation to the external environment. The reactions of the dog can be far more effective if he responds solely to the strongest stimulation rather than splitting his response between two or more stimuli. Subjectively, this phenomenon is referred to as "attention" or "interest."

Unconditional and Conditional Reflexes as Adaptive Mechanisms

From these and related facts, as early as 1903, Pavlov already was able to sketch a systematic scheme which, as he said, "may be the general mechanism of all our observed phenomena of psychical stimulation of the salivary glands." He was not yet ready to give it a name, but the sketch had been confirmed, as well as elaborated, by thousands of experiments and is to this day the key to objective knowledge, not only of the psychic stimulation of the salivary gland, but of the physiological basis of psychic phenomena in general:

"Let us now consider some of our facts physiologically, beginning with the cardinal ones. If a given object—food or a chemical—is brought in contact with the special oral surface, and stimulates it by virtue of those of its properties upon which the work of the salivary glands is especially directed, then it happens that at the same time other properties of the object, unessential for the activity of these glands, or the whole medium in which the object appears, stimulate simultaneously other sensory body surfaces. Now these latter stimuli become evidently connected with the nervous centre of the salivary glands, whither (to this centre) is conducted through a fixed centripetal nervous path also the stimulation of the essential properties of the object. It can be assumed that in such a case the salivary centre acts in the central nervous system as a point of attraction for the impulses proceeding from the other sensory body surfaces.

Thus from the other excited body regions, paths are opened up to the salivary centre. But this connection of the centre with accidental pathways is very unstable and may of itself disappear. In order to preserve the strength of this connection it is necessary to repeat time and again the stimulation through the essential properties of the objects simultaneously with the unessential. There is established in this way a temporary relation between the activity of a certain organ and the phenomena of the external world."[8]

It is this temporary connection between the organism and its environment acquired during the course of its life, as distinguished from the permanent connection embodied in an original inborn reflex, which constitutes the essential mechanism of psychic phenomena. In the sketch, Pavlov outlines the most general law of temporary connections as their strengthening through repetition and weakening through lack of it.

What are these temporary connections that are so important for establishing and maintaining an equilibrium between the animal organism and its environment? In the first place, Pavlov says they "may properly be considered and termed reflexes." A reflex is "the mechanism of a definite connection by means of the nervous system between certain phenomena of the external world and the corresponding definite reactions of the organism." Both the physiological and psychical nervous mechanisms are reflexes. What, then, is the difference between the two? The physiological reflex is a reaction "in which an external stimulus is transformed into a nervous process and transmitted along a circuitous route (from the peripheral endings of the centripetal nerve, along its fibres to the apparatus of the central nervous system, and out along the centrifugal path until, reaching one or another organ, it excites its activity). This reaction is specific and permanent." In the absence of abnormal vital conditions, reactions of this type are "constant and unchanging" reflexes.

Psychical reflexes, on the other hand, are "subject to fluctuation, and dependent on many conditions. They, therefore, deserve the name of 'conditioned'."[9] Thus the "psychical" mechanism is the conditioned reflex, while the physiological mechanism is the unconditioned reflex. The one is acquired more or less

temporarily during the lifetime of the individual organism. The other is inborn and is part of the physiological equipment of the species.

A further distinction between the two kinds of reflexes is seen in the type of properties of objects which stimulate them. In the *unconditioned* reflex, the *essential* properties act as stimuli, for example, the physical and chemical properties which bear a direct relation to the physiological role of the saliva (to make *dry* food wet and *hard* food soft). In the *conditioned* reflex, the secondary properties of objects act as stimuli, for example, color, form, scent and sound which bear no direct relation whatever to the physiological role of the saliva (the color, form, scent and sound are not the subject of action of the saliva).

Pavlov says that these secondary properties in the conditioned reflex mechanism "evidently receive their physiological importance as *signals* for the first ones, *i.e.,* for the essential properties."[10]

Here at last is the greatest discovery made by Pavlov, the conditioned reflex as the key to knowledge of psychic phenomena. These phenomena are designated "psychic" primarily because they are concerned with the secondary properties or *signals* of objects rather than with their essential properties. Indeed the study of the psychic life of animals is largely the study of the system of *signals* which they develop during the course of their individual lives to adjust to the changing conditions of their environment.

The concept of conditioned reflexes as dealing with *signals* of external objects is one of the richest theoretical contributions ever made to science. It put animal psychology on a sound scientific basis, making it forever inexcusable to read human subjective interpretations into animal activity.

Pavlov's cardinal thesis is the Darwinian principle of the interaction of the organism and the environment. One problem with this principle had always been an implication of predeterminism through inborn instinctive control of behavior. Adaptive changes, in structure and function, were conceived as passing from generation to generation, either on the basis of inheritance of acquired characteristics or by mutation and

selection through survival of the fittest. In this conception, there was little or no basis for individual adaptation during the lifetime of the organism. There was vague talk of "habits," but even here doubt existed as to whether they were individual or inherited.

Pavlov solved this riddle, but not at the expense of determinism. He found the solution to the problem of avoiding pre-determination and still remaining on a strictly cause-effect basis. He did this by distinguishing two aspects of the environment and two different but closely related mechanisms of adaptation to them. Moreover, he did not just speculate on these matters, but demonstrated them through scientific experimentation.

The first and principal aspect of the environment is its relative permanence. The main features of the world surrounding a given animal species remain more or less constant for long periods of time measured in hundreds, thousands and even tens of thousands of years. To these relatively unchanging features the species can with advantage adapt on a long range basis. Long range adaptation means one which belongs to the species through the individual organism. The mechanism for such behavioral adaptation is, according to Pavlov, the unconditioned reflex. An unconditioned reflex is an adaptive response which has become hereditary. Examples are numerous and familiar: coughing when extraneous matter enters the throat; sneezing when such matter enters the nasal tracts; salivating and swallowing reflexes when food enters the mouth; and so forth. Some unconditioned reflexes, like the above, are simple, others exhibit a complex, chain character, such as the thousand-mile journeys of migratory birds or the intricate construction activities of the ant or the bee.

These are what have traditionally been known as "instincts." Pavlov says "we prefer the word *reflex*," because in it there is a clearer idea of determinism, a less doubtful relation of the stimulus to the response, of cause to effect. It can account for extremely involved behavior through "the chain-like character of the process, the compounding of a complex effect from simple components, whereby the end of one action is the stimulus for the beginning of another." Reflex is a scientific term,

sharply defined, and subject to experimentation, simplification and elaboration. On the other hand, the term "instinct" has never been rigidly defined and is thickly overladen with mystical and vitalistic meanings. Pavlov's conception "would include as reflexes the entire complexity of all responsive reactions, and nothing would remain to necessitate the forming of a special group of phenomena known as instincts."[11] In short, all animal behavior can be accounted for in terms of the physiological concept of *reflex* and *response,* and leaves no residue requiring the catch-all notion of "instincts."

The unconditioned reflexes constitute the primary adaptive equipment of the organism. Without them, the animal could not live at all, nor could the species continue to exist. These inborn reflexes are divided into two groups: the sex reflexes which serve to preserve the species; and the food and defense reflexes, the assimilating of food and the preservation of the inviolability of the organism, which serve to safeguard the individual.

The central coordination of stimulus and response in the unconditioned reflex is a function of the subcortical centers, that is, of more lowly portions of the brain.

If the broadly permanent features of the environment were its only features, then the complex unconditioned reflexes would be the sole adaptive system required by the organism for existence. As Pavlov puts it, "However, the equilibrium achieved by means of these reflexes would have been perfect only providing the environment had been absolutely permanent."[12]

The environment is not absolutely permanent. It is only relatively permanent in some of its essential features: there is food to be swallowed and there is extraneous matter; there are two sexes; there are dangers threatening the well-being; and so on. To such features the unconditioned reflexes adapt the organism.

The environment is, however, not only relatively permanent, but extremely varied and constantly fluctuating. Food is not always, or even often, on hand to be taken into the mouth. It must be found. The predatory danger is not always, or even often, present to be clawed or bitten or run from, but must be

avoided before it is contacted. The sex partner is not always or often in direct proximity, but must be sought.

To adapt to the specific and changing conditions of life, there had to be a mechanism opposite to the permanent responses of the unconditioned reflex. If higher animals were to evolve, then an adaptive system more responsive to changing environmental conditions than permanent inborn reflexes had to develop. A mechanism of temporary, rather than permanent, connections, ones which arise and disappear with the appearance and disappearance of fluctuating features of the environment, was required with the evolution of higher animals. Just such a mechanism is the conditioned reflex. This mechanism allows the organism to find food, seek a mate, and ward off dangers. It does this on the basis of various casual and temporary indications which act as signs steering the animal's movements in the direction of food or mate, or away from threats to its existence.

These two mechanisms, the permanent reflexes for permanent features of the environment and the temporary reflexes for the temporary features, complete the equipment of the animal for the establishment and maintenance of the most delicate equilibrium with its surrounding conditions.

The two mechanisms, however, do not simply exist side by side with a division of labor. They are closely related and exhibit definite laws of interconnection. Two simple and always successful experiments will illustrate this point.

Let a mild solution of any acid be poured into the mouth of a dog. It will cause a defense reaction: by lively movements of the mouth the dog ejects the solution, while at the same time a profuse flow of saliva dilutes the acid and washes it away. In this unconditioned reflex action there is already in existence, and has been from birth, a direct path for the transmission of the nerve current. Thus no new paths, no switching, no new connections need to be made. This is one of the mechanisms of defense inherited by the individual from the long evolution of the species. It is a permanent, basically unchanging reflex. The only way it can be made to disappear is by severing certain nerves. It will disappear if the motor nerves of the muscles of the mouth and the secretory nerves of the salivary glands

(*i.e.*, the efferent conductors) are cut. There is one other way it can be made to disappear: if the central station for conducting the nerve current, the portion of the brain (or spine) which performs the function of transferring the nervous excitation from receptor (afferent) to motor (efferent) conductors, is destroyed. In the present case of acid defense, the central station is the medulla oblongata, part of the basal ganglia of the brain.[18] This is the type of mechanism for all the unconditioned reflexes of the animal organism, including human beings.

Now the other experiment. Let any external agent, for instance, a definite sound such as a bell tone, be repeatedly applied to the dog just before the same acid solution is poured into its mouth. After a few repetitions it will suffice merely to sound the bell tone and the same reaction will be produced, the same movements of the mouth and the same flow of saliva. This experiment is just as accurate and just as repeatable as the former. Both are reflexes expressing laws of nervous functioning. Like the unconditioned reflex, the conditioned can be made to disappear by cutting certain nerves, in this case the efferent conductors of the muscles of the mouth and the salivary glands and the afferent conductors from the ear. Here, however, there is already a difference. For the nerves are not solely those of mouth and salivary glands, but include a new set, the nerves leading from the ear—or it could be, in other similar experiments, nerves leading from any of the distance receptors (eyes and nose as well as ears), or even from all at once.

Now a different kind of function is required of the central station, a highly complex function. Since no permanent nervous path is already open from birth between the afferent nerves of the ear and the efferent nerves of the muscles of the mouth or of the salivary glands, it is the task of the central station to open up such a path. A new way along which the nerve current may pass must be formed. It must connect the signal from the ear with the response mechanism of the original unconditioned reflex, setting it in motion just as if it had been stimulated by the mucous membranes of the mouth itself. The subcortical centers are not structurally adequate to perform this operation. A more highly developed organ is required. Such an organ is present in the cerebral hemispheres. It is the function of the

delicate nerve cells of the hemispheres to form the new and temporary connections between nervous excitations coming from signals received by the eyes, ears and nose and the inborn muscular and glandular responses of the organism. This is proved by the fact that if the cerebral hemispheres are destroyed the conditioned reflexes completely disappear, while the unconditioned continue to function.[14]

The two nervous apparatuses for adaptation of activity to the environment are closely interrelated. Conditioned reflexes are formed initially on the basis of unconditioned reflexes. For the formation of conditioned reflexes, the general law is that there must be coincidence (once or in most cases several times) of the new stimulus with the old unconditioned reflex or with conditioned reflexes constructed on its basis.

This is a most important law for the establishment and maintenance of an equilibrium between the organism and the environment. For if the conditioned reflex apparatus were an independent system the hemispheres would be swamped with thousands of meaningless stimuli having no relation to the vital requirements and functions of the animal. The result would be utter chaos. But given the condition that for a stimulus to become an effective sign or signal it must have coincided not only once but several times with unconditioned stimuli, or conditioned stimuli associated with them, then there is already a drastic sifting of stimuli. In other words, the conditioned mechanism is so constituted that it functions only after enough evidence is in to give a reasonable assurance of meaningfulness to the well-being of the organism or the species.

Thus the fact that conditioned reflexes are formed ultimately on the basis of unconditioned reflexes signifies much more than simply that the two mechanisms are related in a certain way. It means that all the myriad possible agents of the external world which can, for example, affect the eyes, nose and ears, can act as stimuli of nervous processes only if they have become related to vital functions of the animal through temporal coincidence on several occasions with one of these functions. It means, in short, that the organism is geared to react only to those signals from the environment which already have a certain guarantee of importance to it.

Here is the first lawful element in the apparatus of conditioned reflexes and it already reveals a high degree of perfection of adaptation in the most wonderful of productions of the material world, the higher nervous system and especially the cerebral hemispheres. After remarking that "the nervous system is found to have two different apparatuses: one of direct conduction of nerve current, and secondly, an apparatus for its switching on and off," Pavlov says in this connection, "It would have been strange to stand amazed when faced by the conclusion. Indeed, on our planet, the nervous system is an inexpressibly complex and delicate instrument for relations and connections between the numerous parts of a living organism and between the organism, as a most complex system, and the infinite number of outward factors which may influence it. If, at present, the switching on and off of an electric current has become a most common technical device in our daily usage, surely there is no reason to argue against the realization of the same principle in the most wonderful instrument that we are now discussing."[15]

Subtle Analysis of Environment by Means of Conditioned Reflexes

But the relationship of the unconditioned and conditioned reflex apparatuses, resulting in a sifting of stimuli, is only the bare beginning of the complex discriminations performed by the higher nervous processes, and more particularly by the cerebral hemisphere. The latter not only sift the stimuli in the first place, but they make the most subtle analysis of those admitted for processing, that is, those which have previously been connected by temporal coincidence with the vital permanent reflexes. The temporary conditioned connection is refined and specialized, and broken up into its constituent parts. It is subjected to the most complex disintegration, and then it is synthesized into the total functioning of the organism. This analytical and synthetical work of the hemispheres accounts for the vastness and depth of adaptation or equilibrium of an animal with its environment.

The analysis performed by the hemispheres is, perhaps, the most intricate of their functions. It involves the process of in-

hibition as well as of excitation. Excitation and inhibition comprise the two opposites within nervous phenomena, which, in their mutual relationships and transformations, account for all the complexities of animal activity. "Nervous activity," says Pavlov, "consists in general of the phenomena of excitation and inhibition. These are, so to speak, its two halves. I shall not commit a great error if I liken these two phenomena to positive and negative electricity."[16]

The formation of new temporary connections is essentially a process of excitation and synthesis. But it is not enough simply to form new connections. To attain to a proper relation of the organism to the surroundings there is required in addition a continual and rapid adjustment of the temporary reflexes toward a greater and greater conformity to the external environment—or to extinguish them if there is no conformity at all. It is the work of analysis and inhibition to carry out the tasks of *correction* of conditioned or temporary reflexes, thus bringing them into line with objective reality. "The whole behavior of the animal," Pavlov says, "is included in this *synthesis* and *analysis*. In order to maintain an equilibrium with the surroundings, it is essential, on the one hand, to analyze as well as to synthesize the external world, because not only simple separate agents act on the animal but also their combinations. . . . The basic processes upon which this synthesis and this analysis are founded, are, on the one hand, the excitatory, and on the other hand, the inhibitory process—this latter a kind of opposite to the excitatory process."[17]

The most elementary, and at the same time important, function of analysis through inhibition is the *extinction* of conditioned reflexes when they do not correspond to external conditions. This process was referred to earlier in this chapter. It is the phenomenon of the gradual withering away of a temporary connection when it is not accompanied by its associated unconditioned reflex. For example, if a bell tone, having been established as a conditioned stimulus for the food reflex, is not followed for several repetitions by actual feeding, then it ceases to elicit the usual salivary response. It is temporarily extinguished as a conditioned reflex, *temporarily* because it can be revived by once again relating it to the unconditioned food

reflex through feeding after the sound of the bell tone is heard.

Inhibition does not mean simply a lack of susceptibility to stimulation. It is, rather, the formation of a block or a resistance to stimulation. It is the transformation of excitation into resistance to it. It is the negation of excitation, not the lack of it.

A more complex form of analysis through inhibition is shown in the following experiment. A bell tone of 500 cycles per second is sounded simultaneously with feeding a dog, and the process is repeated a number of times. Thus a conditioned reflex to a definite tone is formed. If it is periodically reinforced by actual feeding, *i.e.*, by being connected to the permanent food reflex, it produces the same flow of saliva as the presence of food in the mouth. But here a new feature of this classic experiment is added. Let a bell tone of almost any number of cycles be sounded and the dog will react in the same way as to the tone of 500 cycles. Even more, the dog will react to many musical sounds other than the bell tone. What has happened? The fact is that the conditioned reflex in this case has not yet been subjected to detailed analysis, it has only been sifted. It is what Pavlov calls a *generalized* conditioned reflex. As soon as a temporary connection has been formed it tends to spread, to irradiate to neighboring areas of the cerebral hemisphere. Indeed, the excitation will continue to irradiate unless checked by the opposite process of inhibition.

The checking of *irradiation* and its transformation into the reverse process of *concentration* is a function of analysis through inhibition. Life furnishes the conditions for this phenomenon, but experimentally it works out as follows. Wihle the experimenter, by feeding, continually reinforces the conditioned reflex to the bell tone of 500 cycles, he sounds bell tones considerably removed from the 500 one, always without reinforcement by feeding. In this way he strengthens the excitation of the former, and builds inhibitions to the latter. By gradually building inhibitions closer and closer to the 500 cycle tone, he can eventually get to the point of fine discrimination on the part of the animal's nervous mechanism where it will react to 500 but not to 490, for example, or to any bell tones further removed than 10 cycles per second. The irradiation of the conditioned reflex has been checked and transformed into narrower and narrower

concentration. This is what is meant by *analysis* through *inhibition.*

To the animal trainer, the general phenomenon of finer and finer discrimination is very familiar. But Pavlov reveals the nervous processes underlying the *practice* of the training of dogs, horses, seals, etc.

This analytical pin-pointing of the external agent which is the effective sign leading to food, to a mate or away from danger, is a tremendous refinement in the adaptation of the organism to its surroundings. It is to such intricate phenomena in animal behavior that subjective psychologists, and people generally, point in upholding the position that dogs, horses, and other animals actually think, judge and carry out reasoning processes. Pavlov demonstrated through his experiments that the totality of animal behavior can be accounted for in terms of the complex apparatus of conditioned reflexes, without calling on analogies from human subjective psychic life. Animal behavior is most assuredly in many instances subtle enough to be attributed to thought, judgment and reasoning. But Pavlov's work reveals the special mechanism of each of these subtleties, remarkable enough in themselves, and leaves the even greater adaptive perfection of genuine thinking, judging and reasoning to the more delicate apparatus of man's higher nervous processes.

There are many more facets of Pavlov's work on the conditioned reflex system in animals. There are many different forms of inhibitions, for example. But to trace the matter further would be a book in itself. One other aspect of his teachings, however, is especially important for our purposes. Pavlov discovered a form of inhibition different from the adaptive inhibition of which we have been speaking. This other type he calls *protective inhibition.*

Protective Inhibition

The cells of the cerebral hemispheres which have the intricate function of establishing the ever more refined relation of the organism to its surroundings are exceedingly sensitive and delicate. They are subject, therefore, to damage resulting from excessive strain. Protection is afforded by the inhibitory process

which ensues after a prolonged action of the conditioned stimulus without the unconditioned. It will be recalled that, for example, when an indifferent stimulus such as a bell tone which has been temporarily connected to the food reflex, is repeated without reinforcement by feeding, it soon is extinguished by inhibition. This process relieves the relevant cells from unnecessary work and thus allows them to rest and restore themselves.

Another form of protection of the cerebral cells from overstrain is what Pavlov called *the law of the limit of intensity of stimulation.* For every type of nervous system there is a maximum stimulus, a limit of harmless functional strain, beyond which begins the intervention of inhibition. A stimulus, the intensity of which is beyond this maximal limit, instantly induces inhibition. Again the inhibition is a form of rest and restoration. Thus does the nervous system insure its vital units, the cells, from damage by excessive stimulation and over-work.

The law of the maximum margin of stimulation leads to some of the contradictory aspects of nervous activity. Thus a strong stimulus, if it exceeds or nearly exceeds the limit, may produce a smaller effect than a weak one. This phenomenon Pavlov called the *paradoxical phase.*

But the primary form of protection of the cells of the cerebral hemispheres is the one we are all very familiar with, namely, sleep. Sleep is a form of *protective inhibition.* Inhibition, as already noted, has a tendency to spread or irradiate throughout the hemispheres unless or until it is counteracted by its opposite, excitation in the form of some stimulus from the internal or external environment. If it is not checked by such excitation it expresses itself as partial or total sleep. Partial sleep, where inhibition spreads over a considerable part, but not all of the hemispheres, is hypnosis. In this case, countering excitation is present in sufficient intensity only to check the irradiation of inhibition but not to bring about the opposite process of concentration of excitation. The state of normal sleep, on the other hand, develops when inhibition reaches its climax both in intensity and extensiveness, spreading over the entire mass of the hemispheres and penetrating down into the lower portions of the brain to a certain depth.

Sleep is the absolutely essential periodic rest and restoration

of the most delicate and sensitive products of the material world, the cells of the cerebral hemispheres. We all know only too well what effect the excessive lack of sleep has on our ability to see and hear, let alone think or speak. Little wonder that deep, untroubled sleep has always been accounted one of the greatest blessings of man.

Protective inhibition is the ever vigilant guardian of the hemispheres. It can be said either that sleep is a form of inhibition or that inhibition is a form of sleep. For cerebral or conditioned inhibition (what Pavlov calls also *internal inhibition*) and sleep are one and the same process. But there is, of course, a difference. What is the difference between the two states and how does this difference come about? Pavlov answers that "*inhibition* is a partial, fragmentary, narrowly limited, strictly localized sleep, confined within definite boundaries under the influence of the opposing process—that of excitation; sleep on the contrary is an inhibition which has spread over a great section of the cerebrum, over the entire hemispheres and even into the lower lying midbrain . . . either the inhibition spreads and sleep sets in, or the inhibition is limited and sleep disappears."[18] Thus, sleep, in its limited or total state, is the great protector of the health of the higher nervous process and hence of the total organism. And sleep means rest and restoration of the cells of the hemispheres. Sleep, rest and restoration, these are the primary keys to maintenance of health and normal functioning. As we shall see in another chapter, they are also an important basis of the restoration of health once it has been impaired.

Inhibition is clearly just as important an aspect of higher nervous activity as is excitation. "Thus inhibition," says Pavlov, "has two chief roles—adjusting the organism to its surroundings, and secondly leading to sleep."[19] It is both adaptive and protective. It refines, through analysis, the conditioned reflexes to the external environment; and it protects, through the various forms of sleep, the ultra sensitive cells of the hemispheres.

Excitation forms the new connections, but to pin-point stimuli irradiation must be limited by the opposite process, inhibition. The irradiation of inhibition, leading to sleep, protects the hemispheres, but to maintain a waking state and to perform

analytical work, inhibition must be limited by excitation. The healthy functioning of the organism depends on the establishment and maintenance of a dynamic equilibrium between excitation and inhibition. "The entire *behavior* of the animal," Pavlov says, ". . . is dependent upon the balancing of the excitatory and the inhibitory processes, and upon the adaptation of these two to the various agents of the external world."[20]

Pavlov's Polemics Against the Animal Psychologists

As a staunch and militant materialist, Pavlov carried on a continuous running battle with some of the leading animal psychologists of his time. This struggle centered around the question of the objective versus the subjective anthropomorphic approach to the psychic life of higher vertebrates. Could animal behavior be accounted for wholly in terms of the physiology of higher nervous activity, or was it necessary to employ the concepts of human subjective mental life such as intelligence, reasoning, insight and purpose? Underlying this problem was the highly charged question of the materialist basis of psychic life or the mysterious, independent, uncaused origin of mental phenomena—in short, the question of the unity or the duality or non-existence of the immaterial *soul.*

Pavlov's sharpest polemics were reserved, not for the open and avowed theologists, but for those who under the cover of science in effect preached the doctrine of the mysterious, disembodied psyche. Thus he was especially caustic in his indictments of Wolfgang Kohler, and the Americans, Robert M. Yerkes and K. M. Lashley, among others. He wrote of them, "They evidently have the desire that their subject remain unexplained. How strange indeed! The mysterious is what is alluring to them. They turn away from that which can be explained from a physiological standpoint. . . . In this harmful, I would say, repugnant, desire to depart from the truth, psychologists of the type of Yerkes and Kohler employ such barren notions as for example that the ape went off, 'thought at leisure,' as a human being would do, and solved the thing. This is, of course, nonsense, child's play, unbecoming."[21]

He attacked them for denying the connection between mental

activity and the material structure of the brain, for denying the principle of causality in the higher nervous activity, and in general for their idealist conception of psychical activity. He attacked them particularly for "their masked references to the *peculiar nature of mental activity,* behind which, in spite of the seemingly scientific arguments, can be detected dualism and animism."[22]

In one of his famous "Wednesday" talks with his students and collaborators, Pavlov called Kohler "a confirmed animist," and charged that "he can in no way be reconciled to the fact that this 'soul' can be grasped by hand, brought to the laboratory, and that the laws of its functioning can be ascertained on dogs. He does not want to admit this—Kohler is a victim of animism." He felt so strongly about this that in another "Wednesday" talk he said, "Now, we shall pass over from peaceful affairs to, if we may say so, matters of war, to W. Kohler. With him we are in conflict. This is a serious struggle."[23] But he did not limit his polemics to characterizations.

In his famous *Reply of a Physiologist To Psychologists,* published in the American *Psychological Review* in 1932, Pavlov cites one of Kohler's experiments reported in *The Mentality of Apes* and contrasts his own interpretation with that of the German professor. Here is a brief description of Kohler's experiment. A dog is placed in a large cage situated in an open space. Two opposite walls of the cage are solid, through which nothing is seen. Of the other two walls one is a screen, through which clear space can be seen; the other (opposite) has an open door. The dog stands in the cage behind the screen, and *at some distance* in front of the screen a piece of meat is placed. As soon as the dog sees it, he stands a moment, then turns around and goes through the door, around the cage and takes the meat. Kohler interprets this behavior in terms of the dog's "concentration," "ideas," "insight" and "intelligence," all human conscious functions. Pavlov, on the other hand, accounts for the dog's behavior on the basis of conditioned reflexes and their traces which had been formed on previous visits to the experimental set up (Kohler mentions, casually, that the dog had been there before).

A further aspect of the experiment was that when the meat

was placed, not at a distance from, but directly in front of the screen, the dog vainly pushes against the screen, trying to get the meat through it and does not use the door. Kohler interprets this phenomenon in terms of the dog's "forgetting" what he "knew," under the influence of "concentration" on the meat. Pavlov, however, says, "With conditioned reflexes at our disposal we understand the matter easily. Meat lying near at hand strongly stimulates the olfactory centre of the dog and that centre, by the principle of negative induction, strongly inhibits the rest of the analyzers, the other parts of the hemispheres, and thus the track to the door and the roundabout way remain under inhibition." What superficially appears in the animal as "concentration," "insight," "forgetting," etc., is in reality a complex relationship between excitation, analysis, synthesis and inhibition in the nervous system of the dog.

Of Kohler and his colleagues, Pavlov says that "it is clear to me that many psychologists jealously, so to speak, guard the behavior of animals and man from such physiological explanations, constantly ignoring them and not attempting to apply any of them to any extent."[24]

Why do they ignore physiological explanations of animal behavior? Pavlov answers that this "can only be understood by assuming that among them dualism is still to be detected in the form of animism, *i.e.*, the conception of the existence of a peculiar substance which is opposed to the rest of nature and with respect to which it forces the searching mind to hold itself otherwise than to the phenomena of matter."[25]

Pavlov spent thirty years studying the higher nervous processes of the dog, not for its own sake, but to throw light on human mental phenomena. On the other hand, he did not reduce the latter to the former. He was concerned with discovering both the continuity of the nervous processes of man and animal, and at the same time the tremendous qualitative difference.

Chapter IV

CONTRIBUTIONS TO A SCIENTIFIC PSYCHOLOGY

WITH SECHENOV UNDOUBTEDLY in mind, and as though anticipating Pavlov, Lenin in 1894 wrote, "He, the scientific psychologist, has discarded all philosophical theories of the soul and has set about making a direct study of the material substratum of psychical phenomena—the nervous processes—and has given, let us say, an analysis and explanation of such and such psychological processes."[1] Thirty years of Pavlov's life were devoted to the study of higher nervous activity as the material substratum of mental life.

In the course of his experimental work on psychic processes, Pavlov's attitude toward psychology changed radically. But the change occurred largely as a result of his own work.

At the beginning Pavlov vehemently rejected all psychology, claiming that it was in no sense a science. But at the end, after he and his collaborators had laid a firm basis for the scientific investigation of mental phenomena, his attitude had changed to a point where he could say, "I am an experimental psychologist."[2]

Many psychologists, today as well as during Pavlov's lifetime, have disputed his right to call himself a psychologist. By his own admission he had only the sketchiest knowledge of the literature of the field. "I know psychological literature," he wrote, "only through a few leading psychological texts and compared with the available material, through an altogether inadequate number of psychological articles which I have read."[3] How could anyone be considered a psychologist who was not familiar with all the theories of the psyche? Lenin answered this question when he said that it "is exactly as though a metaphysical psychologist, who all his life has been writing inquiries into the nature of the soul (without precisely knowing the explanation of a single psychical phenomenon, even the simplest),

were to accuse a scientific psychologist of not having reviewed all the known theories of the soul. He, the scientific psychologist, has discarded all philosophical theories of the soul. . . ."[4]

Pavlov was not a metaphysical psychologist. He did not *reason* about the soul, and he rejected the kind of psychology based solely upon speculation from an armchair. He was among other things an experimental psychologist, one who developed theories only on the basis of experimentally discovered facts.

The metaphysical psychologists did not attempt serious experimental investigation of mental activity. They did not have even the faintest idea how to go about such scientific inquiry. "That," wrote Lenin, "is the most obvious earmark on metaphysics, with which every science began: as long as people did not know how to study the facts, they always invented a priori general theories, which were always sterile. . . . The metaphysical biologist would talk about the nature of life and the vital force. The metaphysical psychologist would reason about the nature of the soul. The method itself was an absurd one. You cannot argue about the soul without having explained the psychical processes in particular. . . ."[5]

Pavlov at first rejected psychology because he identified all psychology with its metaphysical, introspective form. He had good reason for this, since at the time experimental psychology was in its infancy. Later, after he had established an experimental basis for a science of psychology, he was careful to direct his attacks pointedly at the metaphysical, introspective variety. He fought militantly against this subjective psychology. Almost every paper he wrote, and every speech he delivered, contains polemics against it.

Thus in 1904, in one of his first articles on the subject, Pavlov wrote that higher nervous activity "cannot be successfully studied, unless one utterly renounces the indefinite presentations of psychology, and stands upon a purely objective ground." And in 1906 he wrote that this scientific study "throughout most of its extent has been cluttered with foreign ideas, borrowed from psychology, but now there is a possibility of its being liberated from such harmful dependence." In 1909, he pointed to the millions of words written by psychologists and others to describe and explain the mental life of man, "but

with what results. Up to the present we have no laws of the psychic life of man. Until now the proverb is true that the soul of another is a riddle."[6]

Over and over again Pavlov placed a large share of the blame on "current psychology" for the seeming impotence of science before the brain. This was traditionally the domain of psychology and thus in the study of the highest organ of life physiology sought to find an ally in psychology. The trouble was that psychology had "not yet the right, in spite of its antiquity, to call itself a science. Psychology is still at sea concerning its own essential methods. . . . Thus you see, psychology has not justified itself as an ally in the eyes of physiology."

And in 1910 he levelled a bitter indictment at metaphysical psychology. He mentioned that at first he and his co-workers vacillated between the objective and the introspective approaches to mental activity, and continued, "Why had we formerly, like cowards, returned to the old subjective methods? The secret is simple: because the subjective method is the method of thinking without considering real causes, because psychological reasoning is indeterminate reasoning, recognizing phenomena, but not knowing whence they come nor whither they lead. . . . The psychological explanations were fantastic and without basis."[7]

Underlying all this criticism was Pavlov's materialist approach to mental activity, which was outraged by the idealist basis of metaphysical psychology. His study of the higher nervous processes was an investigation of material events existing in space as well as in time. Contemporary psychology, on the other hand, was concerned with purely spiritual phenomena having no relation to space and only the faintest connection with time. All Pavlov's experiments with conditioned reflexes were studies of space relations taking time to develop. He was concerned with the discovery of the nerve paths along which the excitation moves, concentrates, or is inhibited. His main thesis is that mental activity is higher nervous activity; that without material motion of nerve impulses, there is no mental life.

Material motion involves space as well as time. It involves material extension, and motion from here to there. To study mental activity as though it were in no way dependent on material motion in space and time, is to attempt the impossible, ac-

cording to Pavlov. "This is the reason why it must be perfectly clear," he declares, "that it is impossible by means of psychological conceptions, which essentially are not spatial conceptions, to penetrate into the mechanism of these mutual connections. You must be able, so to say, to point with the finger where the excitation process was at a given moment, and where it has gone. If you conceive of these relations as they are in reality, then you will understand the truth and power of that science which we are vindicating and developing—the science of the conditioned reflexes. It has absolutely excluded from its domain psychological conceptions and has to do always with only objective facts—facts existing in time and space."[8]

Pavlov's insistence that mental activity is dependent on the existence and motion of material nervous processes in no sense means that he denies subjective states. Nor does it mean that he reduces thought, consciousness, etc., to nervous activity. It does, however, mean that if the *mechanism* of these inner mental states is to be studied, it must be studied in terms of nervous activity. The trouble with metaphysical psychology is that it attempts to study the subjective life of man entirely divorced from that nervous activity which makes it possible. The only way "pure" subjective states can be studied is by the subjective method of looking into one's own mind, namely, introspection. Pavlov's point is that metaphysical psychology with its introspective method can never hope to achieve scientific understanding of mental life. Only by viewing mental activity as a function of higher nervous activity, can psychology be transformed into an objective science on a par with other sciences. "This is the reason why," he says, "from the strictly scientific point of view, it seems to me that the position of psychology as a study of subjective states is completely hopeless. Certainly these states for us are a reality of the first order, they give direction to our daily life, they condition the progress of human society. But it is one thing to live according to subjective states, and quite another thing to analyze purely scientifically their mechanism."[9]

Pavlov's attitude toward metaphysical psychology is perhaps best summed up in his statement that "I cannot understand how the present conceptions of psychology, which have *no rela-*

tion to space, can be fitted into a material structure such as the brain."[10]

Metaphysical psychology was not concerned with fitting the mental life of man into the material structure of the brain. On the contrary, its objective and historical task, quite apart from the question of the motivation of individual psychologists, was to support the notion that the human soul was some kind of independent, non-material, non-caused vital force.

It was Pavlov's historical task to demonstrate experimentally, once and for all, that the human soul is caused, that mental life is a function of highly organized matter in the form of the brain. This was a revolutionary task, in every sense of the word, scientific, ideological, political and social.

Little wonder, then, that Pavlov had to fight and fight hard and continuously for the science of conditioned reflexes. That he directed his struggle chiefly against all forms, open or concealed, of metaphysical psychology, is testimony to the fact that by the turn of the century this pseudo-science had become a main reliance of reaction in Russia.

Little wonder also that under tsarism Pavlov and his coworkers had to carry on their vital researches in small, ill-equipped laboratories, with extremely limited human and financial resources, and under constant opposition from official circles.

Little wonder, finally, that Pavlov's laboratories, personnel and financial support were not only adequate but lavish only after 1917. The Soviet Government, the Communist Party, the working and liberated peoples could accept and support with unbounded enthusiasm the teachings of Pavlov. So unstinted was this support, that in 1935 Pavlov told the delegates to the XV Physiological Congress that "We the leaders of scientific institutions are really alarmed and uneasy over the question whether or not we are in a position to justify all those means which the government places at our disposal."[11]

It was this support of science, and especially of the science of conditioned reflexes, which encouraged, and in large part made possible, the later work of Pavlov and his collaborators on psychology and psychiatry. It was this work that led to the change in Pavlov's attitude toward psychology, though not, of

course, toward the metaphysical version which he continued to castigate until his death.

Pavlov's Approach to Human Psychology

Pavlov seldom allowed himself the luxury of speculation concerning the significance for human psychology of his discoveries about the higher nervous activity of animals. He did, however, many times and from the beginning, express his firm conviction that such significance would eventually be found to exist and that it would provide a decisive link in discovering the laws and facts of man's mental life.

In his very first lecture announcing the discovery of conditioned reflexes through experimental work on dogs, he expressed this belief: "Science will sooner or later bring the obtained objective results to our subjective world, and will at once illuminate our mysterious nature, will explain the mechanism and vital meaning of that which eternally occupies the human mind—its conscience, and its tribulations."[12]

It was this belief and hope that motivated all his work. He once remarked, "Only one thing in life is of actual interest to us—our psychical experience," and added, "Its mechanism, however, has been, and remains, wrapped in deep mystery."[13] To solve this mystery, or to lay a firm basis for its solution, was a motivating passion of his life.

But as a scientist, he could do no more than express a reasonable hope so long as he had not actually worked with human higher nervous processes.

It was not until the late twenties that Pavlov pursued regular and systematic work with clinical patients. This work led to the crowning achievement of his career, the discovery of the qualitative difference between the higher nervous processes of animals and of people. This discovery was greatly facilitated by the founding, at his request, of a clinic in connection with his laboratory. Pavlov spent most of his time during the last years of his life working at this clinic.

As a result of his work on hysteria in the clinic, Pavlov announced in 1932 that he had been forced by the facts to hypothesize a supplement to the higher nervous activity of animals

in order to deal with the nervous processes of the human brain. "This supplement," he said, "is the speech function, the last new principle in the activity of the cerebral hemispheres."[14] The mechanism of this speech function constituted the structural and functional difference between the animal and the human higher nervous equipment. Speech, through the mechanism of vocal organs, muscles and nerves, gave man a system of conditioned reflexes far more complex than that of animals. Animals could react to any sensory stimulation from the environment which might become connected with vital needs. Man not only had that same capacity to form temporary connections on the basis of sense stimulation, but in addition could react to words which had become signs standing for sense stimulations and sense objects. Since words are names for classes of external objects and their actions, they are abstractions from particular things and events. This ability of man to react to the environment in terms of abstractions, gave him far greater adaptability. So much greater was this adaptability, that it became an important aspect of the ability to adapt the environment to his needs. Pavlov called this system of conditioned reflexes to language "a second signal system." He called the speech function "a second system of signals" because words are the signals standing for the sensory signals which both animals and man receive from the external world. The sensory signals Pavlov called "a first system of signals."

Pavlov described the speech system of signals, as a special human form of the conditioned reflex, at the XIV International Physiological Congress: "If our sensations relating to the surrounding world are for us the primary signals of reality, the concrete signals—then the speech, chiefly the kinesthetic stimulations flowing into the cortex from the speech organs, are the secondary signals, the signals of signals. They represent in themselves abstractions of reality and permit of generalizations, which indeed makes up our added special human mentality, creating first a general human empiricism, finally science—the weapons of the higher orientation of the human in the surrounding milieu and in himself."[15]

In the course of evolution man had developed a special signal system supplementing the one he had in common with

animals. This second signalling system, the mechanism of which is based on the nerve stimulations from the muscles of the speech organs, makes possible that generalization from experience, and that application of generalizations back again in activity, which is so exclusively characteristic of man. It makes possible social communication through the spoken word, and thought or communication with self by means of silent speech. It is thus, according to Pavlov, the nervous apparatus of the inner life of man. Without the speech system of signals, there can be no human mental activity, no thought, no reflection of reality in the human mind.

It was on the basis of his conception of the speech system of signals in human beings that Pavlov saw a bright future for psychology, but in close relation to physiology. Psychologists would now have a physiological canvas on which to project the subjective life of man. No longer would there be an excuse for speculation about the formation and development of the psychic qualities: perception, thought, will, emotion, etc. They would from here on have to be elaborated in connection with the facts and laws of higher nervous activity. "The above facts and considerations," Pavlov said, "should lead to the most intimate union of physiology and psychology. . . . I am convinced that an important stage of human thought will have been reached when the physiological and the psychological, the objective and the subjective, are actually united, when the tormenting conflicts or contradictions between my consciousness and my body will have been factually resolved or discarded."[16] With such a union, psychology, he believed, could at last become a science.

Pavlov elaborated his theory of the specifically human speech system of signals, together with its inseparable relation to the sensory system, almost exclusively in the field of psychiatry, the diagnosis and treatment of mental illness. We will be concerned with two things: first, the significance of Pavlov's approach to psychology for some basic principles of scientific materialism; and second, the progress now being made in the Soviet Union toward the building of a science of psychology on the foundation of Pavlov's teachings.

Pavlov's Teachings and Some Principles of Scientific Materialism

For the construction of a thoroughly scientific and materialist psychology there are two absolutely essential guiding principles: one, that mental activity is a function of the brain; and two, that it is a reflection of objective reality. These two principles, in their philosophic form, have been primary elements in the Marxist world outlook, dialectical materialism, for a hundred years and more. Moreover, they are inherent in the materialism of science, and have been for some two thousand years. One is a basic premise of materialism, the other of the materialist theory of knowledge. The first holds that matter had always existed and that mind, spirit, consciousness is a late and derivative development depending on a certain organization of matter. The second maintains that human beings through their social practice, including labor and science, discover facts and laws which truly reflect the processes of the external world.

The two principles have been tested and proven throughout the history of the natural sciences, as well as in the theory and practice of Marxist social science. But one link has been missing in this scientific materialist view of the world and of man, the link that a genuine science of psychology, in close union with physiology, alone could supply. The link was the material apparatus, the mechanism, which could at once explain *how* nature produced and produces consciousness, and *how* consciousness reflects reality.

As long as this link was missing, as long as the nervous mechanism was not known, there was a weakness in materialism, a weak link, which was exploited by idealists and employed by reaction to spread ignorance, confusion and convenient fictions about human nature. Metaphysical psychology was the reservoir of this obscurantism, a reservoir with pipelines feeding into all phases of bourgeois ideology, particularly in the era of imperialism.

The science of psychology, armed with the theory and method of conditioned reflexes, including the speech as well as the sensory systems, can supply the missing link and thus eliminate the

last major weak spot in materialism. With the supplying of this link and the elimination of this weakness, the foundation is laid for the full scientific exposure of metaphysical, introspective psychology together with the reactionary ideologies relying on it for support.

The first question, how nature gives rise to consciousness, in terms of the structural and functional mechanism, has within it two of the essential problems of psychology: the origin and development of consciousness in the human species; and the origin and development of consciousness in the individual. The one involves the problem of the transition from ape to man, while the other is concerned with the development of the child from birth. Pavlov furnished the general outline for the solution of these problems. Experimental psychological work in the Soviet Union is beginning to fill in the details, as we will see a little later on. But first we must explore the significance of Pavlov's general outline of an approach to human psychology for supplying the missing link in materialism. We take first the question of the rise of consciousness in the human species.

In his essay on *The Part Played By Labor in the Transition From Ape to Man,* written sometime between 1872 and 1882, Frederick Engels says that the freeing of the hands was the first decisive step. "The hand became free," he says, "and could henceforth attain ever greater dexterity and skill. . . . Thus the hand is not only the organ of labor, it is also the product of labor." But labor did not develop the hand in isolation, the organism as a whole was affected. "The gradual perfecting of the human hand, and the development that keeps pace with it in the adaptation of the feet for erect gait," Engels says, "has undoubtedly also, by virtue of such correlation, reacted on other parts of the organism." Among the "other parts," Engels mentions particularly the organ and function of speech and the change from the brain of an ape to that of man. But of the action of labor on these other parts of the body, Engels remarks that "this action has as yet been much too little investigated for us to do more here than to state the fact in general terms."[17] Thus Engels pointed to a gap in scientific knowledge, particularly of the mechanism of speech and of the higher nervous processes, in explaining the role of labor in the transition from ape to man.

Pavlov's teachings furnish the basis for filling this gap. "The developing animal world on reaching the phase of man acquired," he says, "an exceptional supplement to the mechanism of nervous activity. To an animal, reality is signalled almost exclusively merely by the stimulations—and the traces that they leave in the cerebral hemisphere—conveyed directly to the special cells of the visual, auditory and other receptors of the organism. This is what we likewise possess in the form of impressions, sensations and conceptions of the environment, with the exception of words—visible and audible. This first system of signalling reality is the same in our case as in the case of animals. But words have built up a second system of signalling reality, which is only peculiar to us, being a signal of the primary signals."[18]

Pavlov never accounted for the rise of this second or speech system of signalling reality. Once he remarked that the only thing apes lacked to be human was speech. But historical materialism goes a significant step further. Apes lack speech and the speech mechanism because they never developed into a tool making and a tool using species; they did not attain to the labor process. Pavlov developed a profoundly materialist and dialectical science of higher nervous activity, but he was not a conscious dialectical materialist. Much less was he an historical materialist. He was not a Marxist. Therefore there are gaps in his theory of the development of the higher nervous processes. It is necessary to view this hypothesis of the second signalling system, since it is a special human apparatus, in the context of historical materialism and the Marxist science of society. Most important, it must be taken in conjunction with Engels' thesis on the role of labor in the transition from ape to man.

It will be recalled that Pavlov viewed the first system of signals, the sensory system, in higher animals as a tremendous advance over those forms of living matter which were limited to innate responses. The development of conditioned reflexes signified a far greater flexibility in the adaptation of the animals to changes of external conditions. This greater adaptability developed primarily as a result of refinement in the distance receptors—eyes, ears and nose—and the concomitant de-

velopment of the cerebral cortex with its function of coupling, analyzing and synthesizing the stimuli from external objects. Through this mechanism, anything in the environment, however fortuitous, could play a role, more or less temporarily, of a signal for a more significant object for the animal, relating primarily to the feeding, procreation, or the defense of the organism.

The problem is, how did the human supplement to this mechanism, the speech system, develop on the base of the first system?

Engels pointed out that "in a sense, we have to say that labor created man himself." It was labor, the fashioning and use of tools, that led to all the further essential distinctions between man and other animals. By the labor of hundreds of thousands of years the human hand was perfected. But with the development in manual dexterity there were accompanying physiological and nervous changes, and changes in the relations between people. Labor involved at first the adaptation of bits and parts of the environment to human needs. External objects were transformed through labor into tools and useful products. This marked the beginning of an entirely new level of equilibrium between the organism and the environment. While on the one hand, "the animal," as Engels says, "merely uses external nature, and brings about changes in it simply by his presence," on the other hand, "man by his changes makes it serve his ends, masters it." The very process of labor, fashioning objects with tools and making the tools themselves, means the discovery of more and more of the characteristics of objects, their similarities and differences, and what can and cannot be done with each. Such complicated activity was from its inception *social.* Men, of necessity, worked together in the fashioning and use of tools. Therefore labor by its social character produced another of the essential features of man, human society. The fact that labor required social activity and the fact that it involved the discovery of more and more of the properties of environmental objects, led to the formation of words, speech, language. "In short," Engels says, "men in the making arrived at the point where *they had something to say* to one another. The need led to the creation of its organ; the undeveloped larynx of the ape

was slowly transformed by means of gradually increased modulation, and the organs of the mouth gradually learned to pronounce one articulate letter after another."[19]

It is at this point that Pavlov's conception of the nervous apparatus of the second system of signalling furnishes a link in the understanding of the transition from ape to man. Sounds, gradually stereotyped into words, developed into conditioned stimuli acting as signals of the properties and actions of concrete external objects. Words become an added system of signals, qualitatively different from the more direct signals of the first system. Primarily, they are qualitatively different because they are an abstraction from reality. This character of abstraction is attained in part because a word is a name for an entire class of objects, events or modifications of them, depending on whether the word is a noun, a verb, or adjective or adverb. In any case, a word stands as a sign for innumerable particular instances of the class it signifies. The word "tree," for example, is a verbal sign for billions of particular concrete objects having several characteristics in common, but also having sharp individual differences. The verbal sign stands for the common features which are thereby abstracted from all the endless differences. A main feature of words is to be so abstract as to apply to all concrete instances of a given kind of thing. It is so abstract that it can be a signal in any given concrete case. As signals, words are far more flexible and allow for far greater subtlety in adaptation than the conditioned sense stimuli of animals.

In part also the character of abstraction is attained because the verbal image of objects replaces, or comes between, the objects as sensed and the activity of people. The verbal image, the word in conditioned coupling with the object or action it signifies, is itself connected with other words signifying other objects or actions. Thus instead of an immediate action in response to sense stimuli, there is a conditioned verbal response which immediately leads to further verbal conditioned connections or associations. These verbal associations, if silent in the form of self-communication, are thought. If they are spoken, then it is social communication. The silent or spoken verbal associations may sooner or later lead to action. Thus words as conditioned signals allow man to abstract himself from a situa-

tion sufficiently so that he can *stop and think* or *stop and discuss* before he acts. In this way, the conditioned verbal responses come between the sense stimuli and the response in terms of action. The intervention of verbal associations allows man to react in terms of past experience and possible future effects, rather than solely in terms of the immediate sense stimuli. Even more significant, speech signals allow man to react, not only in terms of his own past experience as generalized in language, but in terms of what he has learned from other men and other generations through spoken or written verbal signals.

An animal, limited to the first or sensory system of signals, upon getting a scent which has become a conditioned stimulus for activity, is immediately set in motion thereby. With a human being, on the other hand, the sight of some external agent, say tracks in the forest, does not necessarily lead to immediate action. It may lead first to a conditioned verbal response, say "deer," which in turn is associated with other words, giving rise to a chain of associations or a thought process. If the person is accompanied by others, some of this process may be expressed in speech. Finally after self-communication by means of verbal associations, and, perhaps, consultation with companions, also by means of words, a course of action is settled upon, and undertaken.

The mechanism of verbal conditioned reflexes is according to Pavlov primarily sense stimuli connected by the cortex with the nerves and muscles of the speech organs, which latter in turn send kinesthetic stimulations into the cortex. In the cortex these kinesthetic stimuli are connected with other conditioned verbal signals. The sense stimuli are the first signals of reality, and in animals are the only signals. But in man, the fact that these sense stimuli give rise not in the first place to action, but to stimulation of the vocal organs which send kinesthetic stimuli back to the cortex for further associations, constitutes a second or speech system of signalling built up on the foundation of the first. It is this second system which constitutes the nervous apparatus of thought, consciousness and mental processes generally. At the same time, the fact that the speech system is absolutely dependent on the first system, that is, on sense stimuli from the external world, which ultimately alone can give rise to

words, insures that there is a close relation between thought and sense experience, between theory and practice. The way a person lives, the kind of social practice he has, will ultimately determine how he thinks and feels.

In terms of the development of the higher nervous processes in the transition from ape to man, the labor process with the correlative development of language, brought along with it the development of the cortex far beyond that found among animals. This was true in part because of the complex and multitudinous necessary nervous connections with the vocal organs, and in part because of the refined connections between the hand and the cortex, arising in the course of ever increased dexterity and coordination of eyes and hands. The more labor skills developed, the more the various connections between the hands, the sense organs, the vocal organs and the cortex had to develop. But the more they developed, the more refined became the skills. Through this spiral development, with the labor process as determining element, man developed, through roughly a million years, the physiological structure he has today.

The origin of speech, as a result of the labor process, meant, then, that on the basis of the first or sensory system of signals there arose a second, or verbal system. Words are conditioned stimuli subject in general to the same laws that govern conditioned sense stimuli. As Pavlov says, "it is beyond doubt that the essential laws governing the work of the first system of signalling necessarily regulate the second system as well, because it is work done by the same nervous tissue."[20]

This means that the speech system, with its verbal signals standing for sense images, is subject to the laws of the formation and extinction of conditioned reflexes, the laws of analysis and synthesis, of irradiation and concentration, and in general, to the laws of excitation and inhibition, which were discovered by Pavlov to be true of higher nervous activity as a whole. There would be special applications and special forms of these laws as they relate to the work of the second signalling system. There would, in addition, be laws peculiar to this system. But in any case, they would be expressions of the essential laws of nervous processes as disclosed by the experimental work on animals, Pavlov was convinced.

He proved the truth of this conviction to his own satisfaction through his work in the clinic. In his analyses of mental patients suffering from various forms of neuroses and psychoses, particularly certain obsessive, delusional, hypochondrial and depressive types, Pavlov utilized the laws of higher nervous activity and demonstrated their particular application to the second system of signals. This work is explored in the following chapters.

The functioning of the second signalling system, the process of words becoming signals of external objects and events through the medium of sense experience, is achieved by means of the higher nervous mechanism of conditioned reflexes. For man, a word is a conditioned stimulus like all others, and is subject to the general laws of conditioned reflex activity. But as a conditioned stimulus, a word is much more flexible, has far more possibilities of connections and associations, and therefore is on an incomparably higher level compared with the conditioned sensory reflex activity of animals. There is thus both a continuity and a sharp break in the higher nervous activity of human beings and of animals. There is continuity since the higher nervous activity of both is the work of conditioned reflexes. There is a break or a leap because man not only has the mechanism of the sensory system in common with animals, but has the additional apparatus of the speech system.

It is Pavlov's theory of the exclusively human speech system which fills the gap indicated by Engels in his work on the transition from ape to man. The mechanism of the second signalling system, a product of the labor process, was the new nervous development which took place in the transition. It was this development which provided the nervous structure and processes underlying, and making possible, all the complexities of mental life. By filling this gap in human knowledge, Pavlov's science of higher nervous processes makes a tremendous contribution to materialism. It furnishes the final link in the proof of the basic materialist proposition that consciousness, the human mind, is secondary to, and derivative from, matter. For it shows how matter, organized in a certain way, namely the human cerebral cortex with its interrelated sensory and speech systems of signalling, gives rise to consciousness in the course of the development of the labor process. By the same token, ideal-

ism, which views matter as secondary to, and derivative from, either divine or human mental activity, is dealt a devastating blow. It is a devastating but not a final blow. It will not put idealism out of business. For as long as there is a powerful though minority class of people which has a life and death stake in maintaining idealism as a buttress to its control over the majority, there will be concerted efforts both to prevent widespread knowledge of the science of higher nervous activity, and to encourage all forms of idealist and obscurantist notions about mental life, from the theological soul and spirit to the psychoanalytical instinct and Unconscious.

One of the most impelling reasons for this antagonism on the part of the dominant class in our society toward Pavlov's teachings is the threat these teachings pose to an essential pillar of class rule. For literally thousands of years ruling minority classes have had to justify and buttress their privileged position by maintaining that innate superiority gave them the right to rule. From slave owners to the owners of capital, this has been an indispensable doctrine. Whether the innate superiority was conceived as God-given or as the product of heredity, in either case the point was to establish in the popular mind the view that ruling classes rule because of inborn superior mental qualities such as intellect, intelligence, leadership, go-getiveness, self-control, thrift, and willingness to take risks. And conversely, the endless toil and poverty of the masses was the divine or natural result of inborn lack or inferiority of these qualities. Coupled with the doctrine of innate superiority and inferiority is the doctrine of unchangeability: "you cannot change human nature." Thus the division of mankind into classes is the result, not of historical forces, but of permanent inborn differences in human nature. As the saying goes, even if all property were divided equally among the people, classes would soon appear again, because human nature is that way.

The doctrine of innate superiority, however, is not employed solely to justify and buttress class rule. It is used to "rationalize" and implement the domination of one nation over another. Imperialism, with its super exploitation and oppression of colonial and semi-colonial countries, requires this doctrine above all others. How else could the enslavement of one nation by another

be "justified"? And, even more significant, the doctrine of national or racial superiority is a powerful means of keeping the working people of the imperialist nation from joining with the oppressed nations against the common enemy. In this form, the doctrine of innate superiority is chauvinism and white supremacy.

Finally, the doctrine of innate superiority is employed to split toiling humanity down the middle and thereby carry out the policy of divide and rule further. The doctrine of the innate superiority of men over women, male superiority, is a most effective complement to the doctrines of class, national and racial superiority.

In all its forms, the doctrine of innate superiority is an ideological pillar of class society, and particularly of capitalism in the epoch of imperialism. Little wonder, then, that every effort is made to protect, to rationalize and to buttress it. A psychology which makes inborn instincts central, or one that stresses innate intelligence, I.Q., serves the purpose. On the other hand, a psychology based alike on Pavlov's teachings and on the Marxist science of society poses, as it develops, an ever increasing threat to the superiority doctrine.

A major implication of the Pavlovian approach to psychology is that all peoples everywhere, regardless of their stage of historical development, are endowed by heredity with the twofold apparatus of human higher nervous activity: the mechanism of the first or sensory system of signals and the mechanism of the second or speech system of signals. Through a million years, more or less, of the labor process, with its development of head and hand, speech and thought, the mechanisms of the two systems of signalling have become a part of the physiological structure of human beings and are passed from generation to generation. Just as all peoples everywhere, regardless of the type of society in which they live, stand upright on two feet, can grip with their hands, use tools and talk, so are they endowed with the mechanisms of the two systems of higher nervous activity. The higher nervous mechanisms developed and became part of the hereditary physiological structure of man through hundreds of thousands of years. The historical period of class society, slave, feudal and capitalist, comprises at most some

ten thousand years, an almost infinitesimal fraction of the total span thus far. Thus the hereditary physiological structure of human beings, including both mechanisms of higher nervous activity, were fully developed long before the advent of historically constituted society, namely its division into classes. The unavoidable conclusion is that all peoples everywhere, whether tribal or capitalist, have the full capacity to participate in the most advanced form of organization of society. All peoples are endowed with the same essential nervous apparatus for the development of consciousness and human nature generally. According to this scientific psychology, there are no innate differences in the higher nervous mechanisms of classes, races, nations or the sexes.

With regard to the origin and development of consciousness in the individual from birth, there are equally important implications in the teachings of Pavlov. An infant is born with the hereditary apparatus of higher nervous activity, including the mechanisms of the sensory and speech systems. In this sense, all infants are born equal, and can participate fully in any society in which they grow up. A child born, for example, in the least developed tribal society, can be taken near birth into the most advanced society and can master without innate limitations all that that social order can offer. This does not mean that there are not individual differences in types of higher nervous activity, but it does mean that such differences do not determine in advance that one child will develop faster or further than another. Experimental evidence for this will be given shortly.

After birth, the sensory system of signalling is the first to come into action. Until the child develops speech, he adapts to his surroundings by means of the first signalling system of conditioned reflexes built up on the basis of unconditioned ones. With the social unit of the family acting as primary conditioning agent, the infant develops a highly complex relationship with his surrounding conditions of life. But this complexity is accounted for in terms of the analysis and synthesis of conditioned sense stimuli without the aid of language. The infant reacts to the tone of words rather than to their meaning. Thus in infancy there is subtle adjustment at the level of sen-

sory conditioned reflexes, but with no *thought*. The latter develops along with the development of language.

Somewhere between the ages of one and two the child begins the process of acquiring language, thus bringing into operation the mechanism of the second or speech system of signalling. The dependence of the speech system on the sensory system is readily apparent as the child begins to talk. Here the process is clearly one of a verbal stimulus from the outside, from mother or father, in combination with conditioned sensory stimuli from a concrete external object. We all know the process of constant repetition of words as the child looks at or manipulates a spoon, a cup or a toy. Through repetition the child gradually becomes conditioned to connect certain sense images with certain words. The test of this conditioning to language is the child's use of these verbal signs in correct relation to the sensations arising in his play activity. Thus the speech system of signals develops on the base of the sensory system, and then is tested back again in the latter.

The social environment with its communication through language gradually builds the speech system in the child. This is possible because the child is endowed by heredity with the higher nervous mechanism of the speech system. But if a child were deprived of human society at birth, if he were raised by an animal, and such cases have been reported, he would not develop a speech system. The nervous mechanism of the second system of signals would not be brought into action. To activate it requires a social setting in which language, vocabulary and grammar, play an important part. Without such a setting the speech system would not develop and the child would not be able to speak or think, or in any way develop human consciousness.

But given the social setting, the child gradually acquires the system of speech, starting with individual words and moving to phrases, sentences and finally combinations of sentences in logical form. As the child acquires the speech system, a considerable number of speech associations is attained not through combining verbal stimulations with the immediate influence on him of concrete objects of the external world, but through the combination of new verbal signs with already worked out

verbal signals of the actions of objects. Such chains of associated verbal signals can be highly complex and intricate, including many links, each of which may in turn be based on combinations of verbal signs. But in all such chains, however intricate, the starting point must always be based on the combination of a verbal stimulus with the conditioned sensory effect of external objects, that is, with the first system of signals. Thus no matter how abstract thought or speech becomes, it is always ultimately referable to sense experience, to the concrete practice of the person involved. This does not mean that thought must always be true, but it does mean that thought, even in flights of fantasy, must be related to the social experience of the individual.

The second or speech system of signalling, through the higher nervous apparatus with its laws of excitation and inhibition, breaks the sense stimuli from external objects into constituent parts, finding words for each, and then recombines them into synthesized verbal images. The synthesis of separate words into phrases and their combinations, so characteristic of speech, leads to an ever more exact reflection in the second signalling system of objects and processes of the surrounding world, both natural and social. The activity or social practice of the individual constantly leads to inhibition of those combinations of verbal images which do not correspond to external reality, and to reinforcement of those which do.

Throughout Pavlov's treatment of the dynamic correlation between the sensory and the speech systems in human beings, there is consistent emphasis on the reflection-function of both these forms of conditioned reflexes. The work of the higher nervous processes is directed throughout toward more and more exact *reflection* of the external world. Tried and tested combinations of sense signals, together with tried and tested combinations of verbal signals, form images and ideas which more or less accurately reflect objective reality. The double fact that the speech system arises on the base of the sensory system and is tested back in it insures this progress toward more and more accurate reflection.

Thus the science of higher nervous activity is a further confirmation and deepening of the materialist, and particularly the

Marxist materialist, reflection theory of consciousness and knowledge, and of the correspondence theory of truth. "Consciousness in general," Lenin says, "reflects being—this is the general position of all materialism."[21] Sensations are the raw materials worked up by empirical thought and science into the facts and laws which reflect the nature and motion of the external world. The key to a materialist theory of knowledge is that sensations are images of reality. They are stimulations from external objects. Thus Lenin says that "for every materialist, sensation is nothing but a direct connection of the mind with the external world; it is the transformation of energy of external excitation into a mental state."[22] The nervous apparatus of this transformation of energy was discovered by Pavlov in the form of the interrelated mechanisms of the sensory and speech systems.

A grand summary of the higher nervous apparatus, which makes reflection of the external world in consciousness possible, was presented by Pavlov before the Academy of Sciences of the U.S.S.R. in 1932:

"The total integrity of the higher nervous activity I represent thus. In the higher animals, including man, the first mechanism for the complex correlation of the organism with the surroundings is the neighboring sub-cortex with its intricate unconditioned reflexes. . . . These reflexes, i.e., inborn activities, are called out by only a few unconditioned external agents. Hence the limited orientation in the milieu and with it a weak adaptation.

"The second step in the correlation is made by the cerebral hemispheres, but without the frontal lobes. Here arises with the help of the conditioned connections, associations, a new principle of activity: the signalization of a few unconditioned external agents by numberless other agents, constantly analysed and synthesized, making possible an extremely varied orientation in the same milieu and a much greater adaptation. This constitutes a unified signalling system in the animal organism and primarily in the human. In the latter there is added, possibly especially in the frontal lobes, which are not so large in the animal, another system of signalization, signalling the first system—*speech,* its basic or fundamental components being the kinesthetic stimulations of the speech organs.

"Here is introduced a new principle of higher nervous activity (abstraction—and at the same time the generalization of the multitude of signals of the former system, in its turn again with the analysis and synthesis of these new generalized signals), the principle of the conditioning of limitless orientation in the surrounding world and of creating the highest adaptation of the human species—science both in the form of a humanitarian empiricism as well as in its specialized form."[23]

Thus does Pavlov present the main outline of his science of the higher nervous processes underlying mental activity, consciousness, thought, human nature. This is no speculative system, but is the result of thirty-five years of experimental work. He has demonstrated how the sensory system of signals is built up on the basis of so-called "instinctive" reactions, the unconditioned reflexes, and how the speech system develops on the base of the sensory system. To this he adds that in the healthy human being the highest system, the speech system, performs "the dominant (in the waking state) function," and speaks of "the regulating influence of the highest system."[24] Here he takes sharp and fully conscious exception to the teachings of Sigmund Freud. For he maintains that the determining element of mental activity is not the lowest level, human "instincts," but rather the highest system, the speech system. Consciousness, not the "Unconscious," plays the leading and dominant role in man's psychic life. Recent experiments in the Soviet Union, as we shall soon see, fully bear out Pavlov's contention.

Finally, Pavlov's science of higher nervous activity in which the speech mechanism plays a decisive role in making abstraction, generalization, reasoning and consciousness possible, is in complete harmony with the historical materialist insistence on the impossibility of divorcing human thought from language. In his *Marxism and Linguistics,* Stalin says, "It is said that thoughts arise without language material, without the language shell, in, so to speak, a naked form. But this is absolutely wrong. Whatever the thoughts that may arise in the mind of man, they can arise and exist only on the basis of language terminology and phrases. Bare thoughts, free of the language material, free of the 'natural matter' of language—do not exist. 'Language is the direct reality of thought' (Marx). The reality of thought

manifests itself in language. Only idealists can speak of thinking as not connected with the 'natural matter' of language, of thinking without language."[25]

Pavlov discovered the nervous apparatus underlying this impossibility of thought without language. If there were no language, there would be no second system of signalling and man would be limited to the first system of sensory conditioned reflexes, as are animals.

Such is the legacy of Pavlov for a materialist science of psychology. As Pavlov himself would have been the first to admit, it is only a beginning. But it is a pioneer beginning which lays the basis for further objective experimental work. Psychologists in the Soviet Union are now carrying forward this work with the aim of constructing a comprehensive science of human nature. Still in the early stages, the work is full of promise of things to come, as the following section shows.

Some Recent Developments In Soviet Psychology

In a communication read to the delegates to the XIX International Physiological Congress held in Montreal in the summer of 1953, K. M. Bykov, one of Pavlov's co-workers and today a leading scientist and organizer of science in the Soviet Union, summarized, among other things, some of the most recent works on the second signalling system in relation to the first. His communication was entitled *New Data On The Physiology and Pathology of the Cerebral Cortex.*

Of the second signalling system in general, Bykov says, "The second signal system represents all verbal denotations of objects, and this system of signals is taken in by our brain thanks to nervous impulses that arise during the stimulation of receptors of the organs of speech, spoken, auditory and visible, i.e., in the receptors of the organs of speech (muscles of the tongue, lips, cheeks, soft palate, larynx), in acoustic receptors and in visual receptors (during reading). The process of the working out from various words or signals of real stimulations is achieved by mechanisms or working out of conditioned reflexes. This has been precisely established by observations on the formation of

speech in babies beginning to talk." But he adds a caution, which Pavlov himself had given, "As a conditioned stimulus, word, at the same time, is much more manifold than any of the others, and, in this respect, cannot be either qualitatively or quantitatively compared with conditioned stimuli in animals."[26]

To show the essential difference between the activity of the second signal system and the first, Bykov reports a simple and readily repeatable experiment with children from eight to twelve years old.* The ringing of a bell was accompanied by a very slight electric stimulation of a finger causing a reflex of withdrawal of the hand. Thus a temporary connection, at the level of the first signal system, was established between the bell sound and the slight shock. Thereafter, of course, the mere sound of the bell produced the same withdrawal response. This is the classic form of experiment in the production of conditioned reflexes common to human and animal alike. But now, without either the bell or the electric stimulation, and with no previous conditioning within the context of the experiment, simply the utterance of the word "bell," or the showing of the word "bell" written out, produced the withdrawal reflex. As a control, and to demonstrate the fine analysis and synthesis in terms of word signals, other words, spoken and written were tried, with no withdrawal response. Response to the other words was inhibited within the experimental framework.

Here in the lives of the children in the process of getting language, of talking and of reading and writing, the word "bell" had previously become a verbal conditioned stimulus signalling concrete external bells of whatever type. Thus the word stands for the bell and calls forth whatever reflexes or conditioned re-

* Experiments similar to the one reported here have been conducted in the United States. The same is true of several of the other experiments described in the following pages. There is, however, a difference. The Soviet experiments were all *designed* and *interpreted* in the light of the encompassing *method* and *theory* of the conditioned reflex. Those performed in the United States, on the other hand, while in some cases employing the *method* of conditioned reflexes, have been *interpreted* according to a multitude of widely divergent *theories*. Thus there is a coherent unity in the experiments conducted in the Soviet Union which is peculiarly lacking in their American counterparts. This is by no means an insignificant difference, for the unified Pavlovian approach makes it possible to draw highly important scientific and social inferences from a growing body of facts and laws, as will become apparent in the remainder of this chapter.

flexes have been temporarily connected with the actual sound or sight of the bell.

It is at once apparent that the second signalling system is far more flexible in adaptation to the environment. Its key character is *abstraction.* For the word "bell" is itself an abstraction from all real bells and bell sounds and stands ready as a reflectory signal to do the work of actual sensory stimulations from concrete bells. And what is true of the word "bell," holds for hundreds and thousands of other words, and more intricately for their combination in phrases.

Bykov's explanation of the experiment is the following: "Due to the formation at one time of a cortical connection between verbal stimulation and the concrete phenomenon it reflects (in the given case, a definite sound—ringing of a bell), the verbal stimulation has become a signal of a concrete event in the surrounding world. At the same time, this testifies to the 'abstraction from reality,' spoken of by Pavlov, characterizing the second signal system. A verbal stimulation produces the same reaction as the one produced by the absent real stimulation caused by the bell."[27]

Actual life for all of us furnishes endless examples of this abstract signal role of language. Most human activity is concerned with it. Verbal warnings of any kind would be instances. The word "fire," calls forth the same reaction as though we had smelled or seen the actual fire.

Pavlov said that "due to the entire life of an adult, word is connected with all external and internal stimulations entering the cerebral hemispheres, signalizes all of them, replaces all of them, and for this reason can produce all the reactions of the organism, which condition these stimulations."[28]

Another set of experiments, also reported by Bykov in Montreal, demonstrates that the action of unconditioned, inborn reflexes can be completely "covered" by the conditioned reflexes of humans, including signals of the verbal system. One aspect of these experiments is that they would seem to make untenable the current widely held notion that in human beings the so-called "animal instincts" remain intact and unaffected by the acquired behavior and churn like a burning cauldron under a veneer of "civilization," threatening continually to boil over. Bykov

reports two of numerous experiments on the same subject.

The first is concerned with warmth stimulation. In the person under observation, the application to a skin area of a coil pipe with water warmed to a temperature of 110 degrees Fahrenheit was accompanied by the sound of a bell. At the same time a mechanical device recorded the dilation of adjacent blood vessels. The warmth stimulation acting alone produced a certain dilation of the vessels. After twenty to fifty simultaneous warmth and bell stimulations, the action of the bell by itself produced the same vessel dilation. Here again is the classic conditioned reflex phenomenon. Next, it was sufficient to tell the subject person, "I am going to ring the bell," to produce a vessel dilation similar to that produced both by the bell alone and by the warmth stimulation itself. So far this is similar to the experiment with the bell and the slight electric shock. But in the following phase a new phenomenon is produced.

First, a fact which will make this phase of the experiment understandable. Application to a person's skin of a coil pipe with water warmed to 150 degrees Fahrenheit rather than to 110 degrees, produces not a warmth reaction but a slight pain reaction. While the warmth reaction is a *dilation* of adjacent vessels, the pain reaction is a *contraction* of these vessels.

Now, if the person under observation is told, "I am going to apply warmth," while actually the experimenter applies the weak pain stimulus of 150 degrees instead, the reaction is not the unconditioned slight pain response of contraction of the blood vessels, but the verbally conditioned warmth response. The vessels dilated as a result of the verbal signal even though the actual stimulus was for a contraction of the vessels. Thus the person's second signalling system, conditioned reflexes to words, suppressed and replaced, the unconditioned inborn reflex. The person later testified that he had felt a sensation of warmth corresponding to the verbal signal rather than a sensation of pain corresponding to the really acting stimulation (of 150 degrees Fahrenheit). Here both the physiological vessel dilation and the conscious sensation corresponded to the conditioned word signals instead of to the concrete stimulation of an inborn conditioned reflex.

The second experiment cited by Bykov shows much the same phenomenon. It is concerned with the reflex of urination in

human beings. The study was made by introducing warm water into the bladder through a catheter. Pressure changes in the bladder were registered graphically. A gauge in front of the person under observation so he could see it, also showed the pressure created in the bladder. This gauge, however, could be disconnected. Usually the urge to urinate is felt at a definite pressure in the bladder, a pressure which the person under observation sees on the gauge.

After several combinations, of introducing warm water into the bladder to the point on the gauge where the urge to urinate is felt, it was sufficient, when the gauge was disconnected, to tell the person that the gauge had reached that point. Even if he had no water whatever in the bladder, he would feel the urge to urinate. Conversely, if the gauge before the person upon being disconnected, registered zero pressure it was then possible to introduce warm water into the bladder in far greater amounts than would usually produce urination. Here again conditioned reflexes, one of the second system and the other of the first, supplanted or "covered" the unconditioned reflex.

Of these experiments, Bykov says, "numerous similar facts convinced us that the very conception of unconditioned reflexes should be broadened. Under usual conditions every unconditioned reflex becomes 'covered,' as it were, with conditioned reflexes of various complexity." To say that all unconditioned reflexes become "covered" by conditioned reflexes means that in the lifetime of a person, and very, very early in it, conditioned reflexes of both the first and second signalling systems *knit together* with the inborn, unconditioned reflexes (including the so-called "instincts") to form fused reflexes. These reflexes that are fusions of the conditioned and unconditioned reflexes, Bykov calls "complex-reflex" acts. "We have," he says, "therefore, suggested to call complex-reflex acts all normal reflex acts that are the result of the fusion of conditioned and unconditioned reflexes knit together."

Conditioned reflexes are formed almost immediately, perhaps during the very first performances of unconditioned reflex acts. From that point on the unconditioned reflex acts, including complex chains usually called instincts, are carried out as a result of what Bykov calls the "compulsory, interweaving of natural conditioned reflexes into every unconditioned reflex."

This means that the three levels of higher nervous activity in human beings—unconditioned reflexes, and conditioned reflexes of the first and second signal systems—far from existing as mechanically separate systems which interact only, actually, in any given activity, form one indivisible functional whole. But this functional whole is subordinated to its highest phase because the speech system more fully reflects reality. Thus Bykov says that the cerebral cortex "primarily determines by its activity the properties of central formation located below it."[29] And Pavlov wrote that "the higher the organization of the cortex the more it will become the manager and distributor of all the functions of the organism."[30]

The cortex, the organ of the conditioned reflexes, determines and manages the functions of the organism, not as an external agent driving and suppressing lower functions, but by entering into and becoming part of them. This is what is meant by the "compulsory interweaving" of conditioned (including verbal) reflexes and unconditioned ones. Thus any concept of inborn reflexes, instincts, emotions, which preserve their original state intact under a suppressive or sublimative overlayer of "civilized" habits appears metaphysical and mechanical in the extreme.

These experiments and the conclusions to which they lead are clearly of great importance to the developing science of psychology.

Another set of experiments carried on in the Soviet Union has to do with the formation of psychic processes in human beings. This subject is closely related to the science of pedagogy.

These experiments and generalizations were reported at the XIV International Congress of Psychology, held also in Montreal, in 1954. The report, *Formation and Nature of Psychic Properties and Processes in Man,* was made by Professor A. Leontiev of the Department of Psychology, University of Moscow.

Professor Leontiev introduced the subject by saying, "The study of the nature and of the formative laws of the psychic qualities of man is a very important task of psychology, and one of the most difficult."[31] To do this in the spirit of materialist science, the psychologist cannot limit himself to an *introspective* account of man's psychic qualities and their interrelations. Nor does a *description* of their evolution in the growth of children suffice. "It is a question," Leontiev says, "of discovering the real

functional mechanisms of this or that psychic property, and this is the principal path of psychological research. . . . We state the question in this way because we begin with the idea that the psychic properties and processes of man are the result of dynamic systems of cerebral links (conditioned reflexes), elaborated in the course of man's life." Psychic qualities, ability to locate sounds accurately in space, to reproduce vocally sounds of a given pitch, ability in arithmetic and other intellectual capacities, are not inborn, but are acquired in the course of one's life through conditioned reflexes. Experiments to indicate that ability is essentially a matter of education, in the broad sense, were reported by Leontiev.

The first series of experiments reported is concerned with the mechanisms of the most elementary properties such as the location of sound in space. The objective of the experiment is to show that these elementary psychic abilities are acquired during the life of the individual through the mechanism of conditioned reflexes. An electric light bulb and a hidden telephone bell were placed before the subject. During the first phase of the experiment the light bulb and the hidden telephone bell were located one behind the other. This produced, through several repetitions of the bell sound, an association between the bulb and the sound stimulus. After a number of repetitions of this association, the bulb and the hidden bell were moved apart so that they operated from different angles. Now because of the association previously formed, the direction of the sound appeared to the subject to be displaced toward that of the bulb.

An entire series of experiments of this type "prove that the mechanism which manifests itself functionally in the universal psychic capacities of man, such as the capacity to perceive the spatial character of objects, to localize sound in space, etc., are based on conditioned reflexes." This means, of course, that they are not inborn but acquired. These elementary psychic capacities are called "universal" by Leontiev because their "mechanisms are formed under the influence of conditions acting similarly on all people, and therefore are more or less the same for all, but for the exceptional cases."

Everyone, in the course of his life, is subjected from birth to innumerable sounds with the result that gradually he learns to locate the direction from which they come. This happens without any special training or any special conditions that are

very different in individual cases. The similarity of the conditions produces, therefore, similarity in capacity for all of us to locate sounds in space.

This experiment may not seem important or specially significant at first. But when it is seen to what it is leading, it takes on real meaning. The key to this meaning is in the similarity of conditions producing similar capacities. This is a basic implication of conditioned reflexes: the same external and internal conditions will produce the same conditioned reflex. Conversely, and here is the point, conditions which vary considerably for different individuals will produce different conditioned reflexes —or different abilities and capacities. Thus Leontiev says "These simple and common properties (capacity to locate sound in space, for example) greatly differ from those which are not necessarily formed in all individuals. The peculiarity of these special properties or faculties resides in the fact that the formation of the systems of conditioned reflexes of which they are the expression takes place only under certain conditions. These systems therefore are not always formed, and their structure varies from individual to individual." These more complex psychic properties of individuals, the result of varied individual conditions under which the intricate system of conditioned reflexes are formed, are widely supposed to be inborn capabilities—as measured by I. Q. tests, etc., and as manifested in "retarded classes" in the U.S. school system. Speaking of these psychic capabilities, Leontiev says, "Their study is of great interest because their functioning often *appears* to be the expression par excellence of inborn capacities, which certain individuals would lack from birth."

Leontiev reports two sets of experiments concerned with the nature and formation of the more complex psychic capabilities. The first deals with the ability to reproduce vocally sounds of a given pitch. "According to singing teachers," Leontiev says, "certain students appear completely lacking in this faculty."

The subjects of the study were children who were incapable of vocalizing their auditory perceptions. Not only could these children not reproduce a given musical note, but they could not even adapt their voices to the musical note given them—that is, they could not sing in unison. The experiments were designed to establish in these children a necessary differentiation

and control of the sound of their voices, by forming indispensable links or stages in vocal and acoustical connections. The sound used was an electric device and another device registered the sounds emitted by the apparatus and by the child.

The first step was to get the child, through patient practice, to accord his voice to the pitch of the sound as he heard it. When the capacity was achieved, the next step began. Now the sound was stopped and the child continued to sing the note by himself. After proficiency was acquired in this, he was asked to reproduce a note after an interval of six seconds from the cessation of the sound. When this was accomplished the child was taught to reproduce simple melodies.

Another series of experiments was conducted, designed to analyze the nature of the process under study.

The final result of the experiments, *covering eight to ten sessions only,* was that the children, all of whom had given wholly negative results in tests given prior to the special training, now in the same tests achieved distinctly positive results. They could sing in unison and reproduce notes on pitch by themselves.

How could such positive results with these "tone deaf" children have been obtained after so few experimental sessions? "That is explained," Leontiev answers, "by the fact that at the start they did not possess the simple ability which is usually formed in people before any systematic education." They were not sufficiently subjected in pre-school years to musical sounds. Thus the external conditions for the formation of this psychic capacity were absent, so the ability to vocalize on pitch did not form. "The mechanism of this ability," Leontiev reports, "is represented by a system of simple auditory and vocal connections, but of a particular kind. The particularity of these connections consists in the fact that their formation under normal conditions is a response to complex sonorous stimuli in which the role of 'strong stimulus' is related to the pitch of sound. That distinguishes them from auditory and verbal connections in which the pitch of the sound does not play the principal role." Spoken language does not develop conditioning in relation to pitch because here pitch is not the primary element. Only exposure to, and participation in, singing, conditions of life which include song, can develop through conditioning the capacity to reproduce sounds of a given pitch.

The children in the experiments had to learn in a packaged form what most children acquire without special training. The first link in the formation of musical ability had been skipped by these children, due to the absence of necessary conditions. The object of the experiments was to supply the conditions and thus form the link which would then make it possible to develop further musical ability. "It is precisely the absence of this link," Leontiev says, "the formation of which was prevented by certain circumstances of the subject, that leaves the child unable to learn to vocalize musical sounds and melodies heard. Our experiments merely reconstructed the missing link."

On the basis of these and many other related experiments, a tentative conclusion is drawn with regard to the formation and lack of formation, or inadequate formation, of psychic capacities:

"The development of the psychic capacities of man passes through a series of stages in the course of which are formed component links which are indispensable for the formation of the specific mechanism at the basis of the given property or faculty. But certain of these links are generally formed in a spontaneous fashion which escapes the control of the educator; this is why when a precedent link in the mechanism is lacking or badly formed, there is the appearance of a deficiency. If the missing link is discovered and formed, development continues in a normal fashion."

Thus psychic properties are conceived not only as being formed in the course of the life experience of an individual, but also as consisting of stages, and *links* of stages, of formation. These *links* and *stages* must progress from the simplest, most elementary mechanisms to the more and more complex. If earlier links are missing, or are badly formed, then *inability* or *deficiency* appears in later links or stages. Finally, these *incapacities* may be eliminated by supplying the missing links.

Another set of experiments, reported by Leontiev, applies this same idea to the study of the formation of intellectual capacities. A study of school children who were backward in arithmetic showed that their mechanism of elementary calculation was badly formed. The experiments made with these children consisted in taking them back to the stage at which the missing link or mechanism is formed, in order to reform that

link and bring them back into the normal classroom work in arithmetic. The results of this experiment demonstrated "that it is possible to make the backwardness of students in this respect disappear in a rapid and radical way."

Further experiments revealed the functioning of this "mechanism of elementary calculation." They showed that its formation begins with activity with objects, starting with hand and finger movements and progressing to movements of the eye.

The next link is the substitution of external discourse, adding by one "out loud." Following this, the child begins to add by one, saying the words to himself. Here words, aloud or silent, take the place of activity with objects. Instead of moving blocks or fingers, the child "moves" their signals, i.e., words.

The third major link is marked by a decisive change. The process undergoes a sharp contraction. It is at this moment that the mechanism of the specific psychic capacity of elementary calculation is formed. The leap is made from adding-by-one in terms of either objects or words, silent or aloud, to complete abstraction from individual objects. This is accomplished by use of words that are generalized images of objects of whatever kind. $10 + 10 = 20$ is abstracted from specific objects, and represents a generalized quantitative form applicable to all objects. Here previous links have already disappeared, having become useless. As conditioned reflexes, they are extinguished. What remains is a new system of reflexes forming a stable but dynamic stereotype. In this stereotype, only numbers and the relations between them play a role as conditioned stimuli: $2 + 2$, we are all so conditioned as to say "4" at once. These numbers and relations, highly abstract as they are, still reflect reality.

Once this abstract stage has been reached, the process of reaching it, the process of its formation through previous links, drops out of sight. Thus the psychic capacity of calculation with numbers *appears* to be inborn, the effect of a mystical "psychic force." It "looks like" the manifestation of a special intellectual capacity which some have innately and others do not. Here again the bare *appearance* tends to buttress the mythology of individual, class and national superiority. But "In reality," Leontiev says, "this capacity is nothing else than the fruit of the experience of actions, assimilated, reflected, and modified in the brain of man. It must be emphasized that each individual

assimilates the actions which are taught to him by others; these are created in the historic process of evolution of human society, the development of social life."

If children "have difficulty" with arithmetic it may well mean, then, that they did not make the leap to abstract calculation, with its mechanism of a dynamic stereotype of certain conditioned reflexes, to "pure" number signals; that they missed one or more earlier links which would have made this step possible. Perhaps they are at the level of "finger counting," or word-object counting. This deficiency may not be discovered for some time in school, for by *primitive* methods, appropriate to earlier stages, a child can appear to keep up with his class for a time. He may subtract and add by direct counting, and "get by" with it until the complications of the subject go beyond the capacity of such calculations. "Since in school," Leontiev says, "one often judges the quality of the work done by the results obtained, students having recourse to such operations (e.g., direct counting) appear to be carrying out their work well for a time. But when they enter a higher grade, they are no longer able to carry out their school grade, and are unable to progress in their studies." In that case, the missing link or links must be found and reformed, according to their specific laws and the general laws of extinction and formation of conditioned reflexes and dynamic stereotypes.

Of all these experiments and studies, and hundreds like them, only far more complex, Leontiev concludes, "Let us say that the psychic properties of man, whether common to all or special, are not expressions of some 'psychic force' of which the presence or absence can only be noted, but that they are definitely the results of ontogenetic evolution . . . the psychic properties and the individualities of human beings are not inborn, but are always formed in the course of man's development and training. The knowledge of the laws that control their formation makes it possible to direct these processes."

And he adds one final note, "The study of the laws of the formation of the psychic properties serves a great practical object: the most complete possible development of the capacities of all men. The Soviet psychologists see this as one of their fundamental tasks."

In this way, Pavlov's legacy of principles and methods in the

objective study of the nervous processes underlying mental life is being developed, elaborated and, what is more, applied to the practical tasks of education.

Psychology is becoming a science, and a science in the highest tradition, a science leading to practical results in helping to transform man and to change ignorance of oneself into knowledge. The field, however, is immense and is concerned with the most intricate processes developed by nature. It is not as yet possible to account fully for the formation and development of the higher nervous mechanisms of many of those aspects of mental life which have occupied the minds of psychologists, philosophers, and poets down the ages: perception, attention, memory, imagination, thinking, feeling, will, personality. But the first and main task has been accomplished. Psychology has been taken out of the realm of speculation, introspection, description and classification, and put firmly on an objective experimental basis.

Pavlov noted that as a science, psychology will proceed at a much slower pace. It will not, as heretofore, in each psychologist's system, account for all psychic phenomena in one grand theory. But its progress, while moving far more slowly, moves surely from fact to fact. "Mr. Fact" rules the science of psychology. Gradually the whole of man's inner life will become known. It is not the time for system-building in psychology; it is time for hard, strictly objective, experimental work.

K. M. Bykov, at Montreal in 1953, summed up the situation in the new science of psychology:

"Such a complicated field of investigation as the study of the higher nervous activity has, of course, not been completed. Pavlov, himself, wrote at the end of his famous treatise: 'Here is a mountain of the Unknown, and it evidently will for a long time remain much bigger than the pieces we have torn out and perceived.' It is not easy to create a principally and methodically new science concerned with the activity of an organ whose study human thought started twenty-three centuries ago. I have no doubt that in treading the path opened by I. P. Pavlov, we shall, in concert with capable and talented investigators throughout the world, be able to perceive the laws of thought and instruction. This will mean that we are gaining the highest blessing—that of knowing ourselves."[32]

Chapter V

EXPERIMENTAL PSYCHIATRY AND MENTAL ILLNESS

PAVLOV FIRMLY BELIEVED that "only by passing through the fire of experiment will medicine as a whole become what it should be, namely a conscious and hence purposefully acting science."[1] He had in mind particularly the help that experiments with animals could provide in solving questions of the pathology and therapeutics of the nervous system. "I am convinced," he wrote, "that the decision, or the condition favorable to a decision of many important questions of etiology, the natural systematization, the mechanism and finally the treatment of neuroses in the human being lies in the hands of the animal experimenter."

Here he was supplying a fundamental methodological principle of science: the analysis of the simple to help examine the complex. "Consequently," he says, "the human neuroses should be explained, understood, i.e., analyzed, by help of the animal neuroses, and not by the reverse procedure."[2] This is not the reduction of the complex to the simple; it is not the *identification* of human with animal neuroses. It is the use of the simple insofar as it can help throw light on the complex. Animals and men have much in common with regard to their higher nervous processes, which fact forms a basis for the methodology. At the same time, the speech system and the social environment based on the labor process mark a qualitative leap between animal and human being, making impossible the reduction of the one to the other. Finally decisive is the fact that it is all but impossible to experiment systematically with the human nervous system. Thus if medicine, and particularly psychiatry, is to be an exact experimental science, animals must be the primary subjects. There can, however, be no mechanical application to the human organism of knowledge gained from ex-

perimentation with animals. This is true for physiology and medicine as a whole, but doubly true for the physiology and patho-physiology of the brain.

Throughout most of his work on higher nervous activity, Pavlov pursued his investigations on three levels: physiology, patho-physiology and therapy. He was concerned with discovering the facts and laws of the brain in a healthy state primarily so that he could go on to discover the mechanisms underlying mental illness, and these in turn so that he could repair and restore them. He was a doctor, and curing the sick was always his essential motivating objective.

Pavlov's study of disturbances in higher nervous activity went through three stages. First, he made an experimental study of the effect of lesions, artificially produced by surgery, on the functioning of the brain and the nervous system. Here he was concerned primarily with two problems, localization of functions in the brain and the so-called *organic* form of mental illness, as opposed to the *functional* form. Organic illness involves damage to, or destruction of, parts of the brain, while functional illness involves disturbances of nervous processes which may or may not lead to damage or destruction. The method of surgical lesions, including extirpation, was, of course, employed solely on animals.

In the second stage of his study of the causes and cures of mental illness, Pavlov artificially induced functional disturbances of the higher nervous activity in animals, in order to discover the mechanisms of various neuroses and to experiment with possible forms of treatment. Here he employed his famous method of *experimental neuroses.*

Finally, in the third stage of this work, Pavlov made intensive investigations of mental illness in the psychiatric clinic which the Soviet government had established, at his request, in connection with his laboratory. Here at last he was able to study neuroses and psychoses in human beings, and to put to clinical test the vast store of experimental knowledge he had acquired in the course of his work with animals. During the last few years of his life, Pavlov worked simultaneously in the clinic and the laboratory, with the former setting ever new tasks for the latter. The work led to a new approach to mental

illness, its nature and treatment, including a new organization and regimen for the mental hospital.

In the present chapter, we are concerned with the work carried forward in the first two stages, namely the experimental study of lesions and of neuroses in animals. We begin, then, with an account of Pavlov's experimental study of pathological states of the higher parts of the brain caused by artificial, that is, surgical, lesion.[3]

Toward an Understanding of Organic Mental Illness

The first step Pavlov took toward the study of mental illness was to investigate experimentally with the pathological states induced in animals by surgically destroying various parts of the brain. Here his main purpose was to construct rough and simplified models of organic lesions of the human brain. His method was to remove the cerebral hemispheres, or various parts of them, and then to study the resulting changes in the reflex activity of the animals. Through this work, he developed a new theory of the localization of functions of the higher parts of the brain which is of the greatest value for psychiatry.

Destruction of parts of the brain for experimental purposes was not originated by Pavlov. Scientists had been doing it at least since 1850. But they had approached it in a quite different way. After removing part of the cerebrum, they viewed the resulting changes in behavior from a subjective psychological standpoint. This approach was a logical consequence of their theory of localization. For the old theory of localization of functions of the brain was based on the concepts of psychology. It sought to find in the cerebral cortex precise centers for sensations, voluntary movements, association, memory and even for the formation of general ideas. Thus the brain was divided into areas supposedly corresponding to the demands of introspective psychology. This is called the "psycho-morphic" theory of localization, and is still widely held, with entire schools of psychiatry being based on it. Pavlov, on the other hand, studied the changes resulting from extirpation by the objective method of investigating what had happened to the unconditioned and conditioned reflexes, and on the basis of the obtained facts, developed a new theory of localization which has broad impli-

cation for the analysis and treatment of organic mental illness.

The initial experiments were designed to establish the most general division of labor within the brain. For this purpose, the entire cerebral cortex was removed. It was found that with the loss of the cortex the animal could make no new temporary connections or conditioned reflexes. Not only that, but all the conditioned reflexes acquired in the entire lifetime of the animal disappeared. Its past experience was completely wiped out, and at the same time it could acquire no new experiences. The only thing that was left was the unconditioned reflex activity, alimentary, self-defense, sexual, etc., with which it was born.

From these experiments, Pavlov concluded that the cerebral cortex is the seat of all conditioned reflex activity. It has the double function of making new connections between the organism and the environment and of preserving the old ones previously formed in the lifetime of the animal. It makes learning by experience possible. These same experiments demonstrated that the lower parts of the nervous system—the sub-cortex, the brain stem and the spinal cord—comprise the seat of the unconditioned reflex activity, the permanent connections between the environment and the organism which had become hereditary in the course of evolution of the species.

Thus the first and most basic localization of functions of the brain is concerned with the seats of the conditioned and the unconditioned reflexes: the one effects and preserves the experience of the individual; the other effects and preserves the experience of the species.

In the course of the experiments involving removal of the entire cerebral cortex, it was found that the loss of the cortex led to disturbances, more or less profound, of the functioning of all the internal organs of the body. Not only the relationship of the animal to the external environment was upset, but also the whole internal life of the organism, what Pavlov called "the internal environment." From this it was concluded that, while the functioning of the internal organs, glands, etc., was primarily controlled by the lower parts of the brain, the cortex played an important regulating and coordinating role which adjusted the functioning of the internal environment to the external conditions of life. Thus Pavlov arrived at the grand con-

ception of the cerebral cortex as the organ responsible for establishing and maintaining a dynamic equilibrium between the external and internal environments. It could be presumed therefore that any disturbance of the functioning of the cortex would lead to disturbances within the body as well as to disturbed relationships between the organism and the surrounding world. This theory was tested in experiments involving removal of various parts of the cortex.

Through many years of experimental work in which parts of the cortex were systematically destroyed and the resulting changes studied by the method of conditioned reflexes, Pavlov and his co-workers established that the entire cerebral cortex is a receptor surface consisting of a number of more or less specialized receiving areas. Each of these areas are projections of certain internal or external peripheral receptors, that is, they are the areas in the cortex for receiving signals from the muscles, organs and glands on the one hand, and from the sense organs of taste, smell, sight and hearing, on the other. But the function of the specialized areas is not limited to the reception of signals from the external and internal environments. They also break down these signals, analyze them, and then make new connections or associations. Thus they have both an analytical and a synthetical function. Pavlov viewed the cortex as a mosaic of areas, each doing a special job of analysis and synthesis of the signals coming from the body and from the environment, and at the same time, each area having the capacity to make associations and connections with other areas. He therefore rejected the notion of a special area for association. The entire cortex with all its areas performs the task of making associations or temporary conditioned connections.

Likewise in these experiments it was discovered that the areas of the cortex are not neat little fenced-off plots, as in a suburban subdivision, but rather they are composed of a nucleus of highly specialized cortical cells with a progressively less specialized outlying zone. This outer zone of cells overlaps, at its periphery, with the outlying zones of other areas. As a matter of fact, the periphery of each of the zones spreads out over a wide surface of the cortex as a whole. In the cerebral cortex, then, there are, on the one hand, regions performing specific

and highly developed analytical and synthetical functions (the nuclei of the areas) and on the other, regions located in the intervals between nuclei. In these intervening areas there are cells belonging to various specialized nuclei, capable only of elementary analysis and synthesis.

It was found that when the central part or nucleus of an area of the cortex was partially damaged, the most complex forms of its analytical and synthetical activity were the first to suffer. But with the lapse of time the damage tends to disappear and the disturbed function to be restored, depending on the extent of the damage. When, however, the nucleus of an area was completely removed, it was for the most part impossible to restore the specialized functions, and only the cruder analyses and syntheses of the peripheral zones remained.

In all the experiments involving removal of, or damage to parts of the cerebral cortex, it was found that the injury was immediately followed by massive diffused disturbances spreading over vast regions of the cortex and extending down into the subcortex and the brain stem. The first consequence of any partial extirpation is a disappearance of conditioned connections lasting from one day to several weeks or even months. Pavlov explained this phenomenon in terms of protective inhibition. An injury to one part of the cortex sets in motion an irradiating inhibition which spreads to many other parts of the cortex and of the brain as a whole. The function of this inhibitory process is to protect the highly reactive cells of the brain. With the passage of time the protective inhibition, which had at first irradiated, begins to withdraw and gradually concentrates around the site of the injury. Thus the specific pathological symptoms of the injury begin to show up only after the process of concentration of inhibition is completed. Prior to that, general disturbance prevails throughout the cortex and the lower parts of the brain.

Pavlov found that the process of gradual concentration of the protective inhibition, following its irradiation, passed through stages in which the evolutionary oldest parts of the brain were the first to be liberated from inhibition. For example, the unconditioned reflexes centered in the lower parts of the brain were released from inhibition earlier than the conditioned reflexes centered in the cortex. Likewise, older, more firmly es-

tablished conditioned reflexes were liberated before the more recent temporary connections. This fact accounted for some of the peculiar changes in symptoms that succeeded one another in the weeks following the injury to a given area of the cortex.

According to Pavlov, then, two types of pathological conditions follow injury to a part of the cortex: first, as a result of irradiating protective inhibition, general changes occur in the activity of the brain as a whole; and second, as a result of concentration of protective inhibition changes take place directly connected with the place of injury.

Once the process of concentration of inhibition has been completed and the direct effect of the injury has set in, the restorative process begins. The restorative process was found by Pavlov to consist in the development of a "reserve mechanism" which to a greater or lesser degree compensates for the defect of functions caused by the mechanical damage. The reserve mechanisms in the cerebral cortex are in reality the less specialized cells in the outlying zones of the various areas. These peripheral cells, widely dispersed in the cortex, are a source of functional compensation when the nucleus of a specialized area is damaged. Thus, when the central part of an area is injured, the improvement of its functions takes place as a result of the activity of its more or less distant periphery. The mobilization of the reserve mechanism accompanies the final concentration of the inhibition around the site of the injury. The less specialized cells begin to take on some of the less complex functions of the nucleus of the area. Training can gradually increase the compensation for the lost function, but the degrees to which this is successful depends largely on the extent of the original damage.

Through all the experiments concerned with the destruction of parts of the cortex, Pavlov found that the effects of the damage tended to spread over the whole organism, disturbing its internal and external activity. Vegetative functions, concerned with growth and nutrition, were affected, as were somatic functions. This further demonstrated that the cortex plays a decisive role in the regulation and correlation of both the internal and external environments, binding the entire life of the animal into one synthetic whole, a dynamic equilibrium between the

external conditions of life and the internal processes of the body.

This constitutes a further development of Pavlov's general concept of *nervism,* first formulated in his work on nervous regulation of digestion and blood circulation. Now he was able to show that the nervous system coordinates all the functions of the body together with the relation of the organism to the environment, and what is more, that the highest part of the nervous system, the cerebral cortex, plays the dominant role in the delicate work of adaptation and adjustment.

After Pavlov's death, much of the work pursued by his students on the effects of damage to parts of the cortex was directed toward further analysis of the role of the cortex in the regulation and coordination of the internal processes of the body. Of particular interest is the experimental research conducted by E. A. Asratyan on the influence of sleep therapy on the restoration of functions in cases of various surgically induced injuries to the brain. Proceeding on the basis of Pavlov's conception of protective inhibition, Asratyan obtained good therapeutic results mainly by the use of bromides and prolonged narcosis. In general, recent work in the Soviet Union concerned with experimental lesions of the animal brain corroborated and further developed Pavlov's theory of the localization of functions and the effects of organic damage of the cortex. In particular, this recent work fully supports his conception of the role of the cortex in the regulation of the vegetative and somatic processes.

While considerable progress has been made since Pavlov's death in the field of experimental lesions of the animal brain, notably by Asratyan and Bykov, there has been very little application of this knowledge to clinical cases of lesions of the human brain. And yet, as A. G. Ivanov-Smolensky points out, there is "hardly any doubt," that the pathological states produced by the lesions of the animal brain "are rough models, or so to speak, simplified schemes of certain diseases of the human brain."[4] They are, he maintains, rough models of organic diseases originating from wounds, infections, tumours, hemorrhage, etc. They are *models* because in human organic mental illness there are disturbances of the functions of analysis and synthesis of various areas of the cortex together with the phenomena of irradiation of protective inhibition and its concentration around the site of the lesion, and

other similarities. The models, however, are *rough* and *simplified* because, along with common features, there are fundamental differing features distinguishing the human higher nervous activity. Human behavior is socially determined, involves labor activity, and is rooted in the speech function and all that goes with it. Thus any disease of the human brain has a qualitatively specific expression in the social life of the patient, in his labor activity, and in his speech function. At the same time, a certain disturbance is usually present in the relationship between the sensory and speech systems of signalling. All these symptoms are peculiar to organic lesions of the human brain, and would involve differentiated nervous mechanisms.

Experimental lesions of the animal brain, therefore, are literally *rough models* of organic lesions of the human brain. Great caution is required in the drawing of analogies from the former for the latter. The analogy holds only insofar as there are common features. But either extreme must be avoided. While no mechanical application can be made of animal experiments to clinical illness, at the same time claims to relevance should not be rejected. Pavlov, himself made both these points when he wrote:

"If we must be cautious in applying to man our knowledge concerning the function of such organs in higher animals as the heart, stomach and others, similar as they are to those of the human being, and test the validity of the comparison by its agreement with the actual facts, then how great must be our reserve in transferring to man our only recently acquired scientific data on the higher nervous activity of animals. . . . But, on the other hand, a very simplified treatment of this subject on the part of natural science for the time being, of course, must not encounter animosity, which, unfortunately, also happens not infrequently."[5]

It is the considered opinion of leading scientists in the Soviet Union, including Ivanov-Smolensky, Bykov and Asratyan, that further work in the field of organic lesions of the human brain must be developed on the basis of Pavlov's experimental lesions of the animal brain, taking into account the differing as well as the common features. This in no sense means the reduction of the science of psychiatry to the patho-physiology of the higher nervous activity. Of great importance is the descriptive clinical

work, of decades and even centuries, with its wealth of detailed information on syndromes or complexes of symptoms. But it does mean that, in their opinion, psychiatry, if it is to become an exact science, must be based on the Pavlovian science of the physiology and patho-physiology of the higher nervous activity. This is also the case with the future work on functional as well as organic mental illness, as we will see in the following section.

Toward An Understanding Of Functional Mental Illness

In the second phase of Pavlov's work directed toward an understanding of mental illness, he was concerned with the problem of the pathological states of the higher nervous activity of animals caused, not by mechanical damage, but by various injurious influences of a functional character. Whereas in the first place he had developed rough and simplified models of *organic* cerebral diseases, here he constructed rough experimental models of *functional* diseases of the human brain.

Pavlov's work on functional disorders has a double significance; medical and ideological. For the medical science of psychiatry, it is the attempted discovery of the nervous mechanisms underlying and giving rise to the symptoms of neuroses and psychoses, and leading to new forms of treatment. Ideologically, it cuts the ground from under the introspective approach to neurotic and psychotic behavior, especially the psychoanalytical approach. Just as in psychology, prior to the discovery of the nervous processes underlying mental activity, the way was wide open for more or less fantastic theories, so in psychiatry, prior to the discovery of the pathological nervous processes underlying functional mental illness, the way was wide open for fanciful theories of neuroses and psychoses, their analysis and therapy. The theories of Freud, Adler and Jung, of Sullivan, Horney and Fromm were evolved essentially without benefit of any exact science of the pathophysiology of the brain. An analogy would be the attempt to understand the culture of a society without knowing the underlying economic and productive base. In any such undertaking, the unearthed "facts" would at best be purely descriptive and the "laws" or "theories" would, of necessity, be speculative and fanciful. Fanciful theories, whatever the intent of the author, serve only to obscure the real causes at work and very often tend to

fulfill the ideological requirements of reaction. The patho-physiology of functional disease of the higher nervous processes lays the basis for a fully scientific approach to neuroses and psychoses, and thus can serve mankind in two ways; on the one hand, it can help alleviate human suffering; and on the other, it can help to combat mistaken theories.

As early as 1921 Pavlov experimentally induced functional pathological states in dogs. He did this first by confronting the dog's nervous system with excessively difficult tasks. Although not all the experimentally induced states could be regarded as simplified versions of human functional diseases, the fact is that for the first time in the history of science Pavlov in many cases succeeded in producing in the laboratory rough models of disorders in a certain measure analogous to human neuroses and psychoses. Here again, the warning is in order that the analogies extend only insofar as there are common features, bearing in mind that there are always important differing features.

Pavlov experimentally induced and studied functional disturbances of both psychogenic and somatic origin. In the one case, he produced neuroses and psychoses by subjecting the nervous systems of animals to conflicting or excessive external conditioned stimuli. In the other, he produced neurotic and psychotic syndromes as a result of interfering with glandular functions and as a result of infections. Thus he investigated noxious functional influences from both the external and internal environments.

He found that disturbances of higher nervous activity resulting from shocks and conflicts originating in the external world in many cases led also to disorders of bodily processes such as glandular secretions, ulcers, and susceptibility to infectious diseases. He also found that disturbances of higher nervous activity resulting from internal bodily causes often led to a lowering of the point at which a given nervous system would break down when subjected to excessive or conflicting external stimuli. Thus he was concerned with the *interrelation* of psychogenic and somatogenic functional disturbances.

But Pavlov was not only interested in inducing general and local functional disorders and studying their various phases. Throughout some fifteen years of work with experimental neuroses and psychoses, he was, at the same time, continuously searching for effective forms of therapeutic treatment. Above all, he

wanted to be able to cure the diseases he induced, and thereby make progress toward a "scientifically sound psychotherapy," as he liked to put it.

The story of Pavlov's discoveries concerning the pathological nervous processes underlying neurotic and psychotic behavior forms one of the great chapters in the history of medical science. At this moment, when distorted theories of mental illness are widely disseminated, theories that in spite of their author's intent imply that the neurotic personality of our time, rather than the death agony of a social system, lies at the root of war and fascism, at such a moment the story of Pavlov's discoveries takes on a truly current and vital significance. They should be viewed, not only from the specialized point of view, but as part of that truth which alone can effectively guide us. We proceed now, as concisely as possible, to tell the story.[6]

1.. *The Theory of Types*

In Pavlov's laboratory the problems arising at one stage usually set the tasks for the succeeding phase of work. Thus, although the discovery and elaboration of experimental neuroses began in 1921, the preceding decade of experiments had produced an accumulation of unexplained phenomena which could no longer be set aside. It had been found, for example, that with certain dogs it was extremely difficult, if not absolutely impossible, to obtain a transition from conditioned excitation to conditioned inhibition. In these dogs, the excitatory process appeared to be stronger than the inhibitory. Since, however, the laboratory was working on the formation and extinction of conditioned reflexes, such phenomena were at that stage simply unexplained complications and hence were filed for future reference. These and similar complications not only piled up but interfered with the work at hand. As the experiments became more and more complex in the attempt to elaborate the processes of analysis and synthesis, the interfering complications grew to such proportions that they tended to block further work. For it was found that while some dogs stood up well under the difficult tasks with which their nervous systems were confronted, others suffered nervous breakdowns which lasted days, weeks or months. Further, of the dogs that broke down, one group showed one set of symptoms,

and another, not only different but opposite ones. Here finally was a set of facts which required a new theory. As it turned out, two interrelated theories were required to interpret the facts and to allow the experimental work to continue on a new level: the theory of types and the theory of experimental neuroses.

The theory of types of higher nervous activity was evolved by Pavlov over a period extending from around 1921 to the end of his life in 1936. We present it here in the form he finally gave it.

By "type" in this connection, Pavlov meant a definite complex of fundamental properties of higher nervous activity resulting from a blend of congenital and acquired characteristics. In the blend, the acquired properties were considered to be decisive. He distinguished three properties on the basis of which nervous systems could be classified according to type: first, the *force* of the nervous processes of excitation and inhibition; second, the *equilibrium* of these processes; and third, their *mobility*. Force is the property of the cortical cells to endure the strains put upon them by the environment. Equilibrium is the property of equal force and mobility of the processes of excitation and inhibition. Mobility is the property of the processes of excitation and inhibition to change to meet fluctuations in the environment.

On the basis of the first property, force, Pavlov classified all the experimental dogs into two groups, the weak and the strong type of nervous system. In the weak type, when subjected to very strong or protracted stimuli, there occurs a rapid exhaustion of the cortical cells leading to heightened susceptibility to inhibition. This type has a low functional limit of the working capacity of the cortical cells, which, when reached, is accompanied by a rapid development of protective or transmarginal inhibition. The cortical cells of the weak type possess, according to Pavlov, only a small reserve of excitatory substances, and thus a function of the transmarginal inhibition is to protect the deficient cells from organic damage resulting from excessive strain. The weak type therefore shows marked tendencies toward irradiating inhibition. The weak or inhibitory type dog may, for example, fall asleep during an experiment involving very strong or prolonged stimuli.

The strong type of nervous system, on the other hand, is characterized by a high degree of force, that is, it can endure to a far greater extent the strains that may be put upon it. The strong type has a high functional limit of the working capacity of the

cortical cells. Thus very strong and protracted stimuli do not easily reach the limit at which exhaustion and its accompanying protective inhibition set in.

But not all strong type dogs are alike. Pavlov found a major division among them on the basis of the equilibration of the processes of excitation and inhibition. One group showed a marked predominance of the excitatory over the inhibitory process, and Pavlov called this the strong but unequilibrated type. These dogs could establish positive conditioned connections quickly and easily and had gerat ability to endure powerful and protracted stimuli. However, they had severe difficulty in developing conditioned inhibitory connections. In short, they were a highly excitable type, in which had developed a disequilibrium, or disproportion, between excitation and inhibition. Pavlov sometimes called them the strong but impetuous type.

In contradistinction to the strong, but unequilibrated excitable or impetuous type, Pavlov distinguished a group of dogs whose higher nervous activity was both strong and equilibrated. This type not only had a high functional limit of the working capacity of the cortical cells, but could quickly and easily develop both positive and inhibitory conditioned connections. Not all the strong equilibrated dogs, however, are alike. Pavlov divided them into two types, the lively and the quiet. The lively type dogs have a good mobility of the nervous processes. They can meet changed living conditions quickly and relatively easily. The quiet type dogs have less mobility and show a certain stagnation and inertness of the cortical processes. Thus this final subdivision of types is based on the property of mobility.

There are, then, according to Pavlov, four essential types of higher nervous activity in animals: two extremes, namely, the *weak inhibitory* and the *strong excitable;* and two forms of the strong but balanced or equilibrated, namely, *lively* and *quiet.*

The classification of the dogs' nervous systems into four types was based on observations made both in the laboratory and in more natural surroundings. But Pavlov cautioned that the actual number of types was by no means limited to four, that there were undoubtedly many more and that further work on the subject was necessary. And yet, in the experimental work, it was found that different types of nervous systems responded in both different and opposite ways, and that the four types best corresponded to

the facts. We will see the importance of the theory of types when we investigate Pavlov's findings with regard to experimental neuroses. First, however, it is important that the question of the *formation* of types be understood, particularly the question of the relative significance of heredity and environment in the evolution of types of nervous systems.

It was stated earlier that the type of higher nervous activity was a product of both congenital and acquired characteristics, and that, in this blend, the dominant role was played by environmental factors acting during the lifetime of the individual animal. Pavlov's laboratory carried out a number of experiments proving the decisive part played by the environment. In one of the experiments, four puppies were taken from one litter. Two of them were kept in a kennel and two were raised in natural surroundings. This meant that the first set was limited in experience of the external world and therefore had little opportunity to develop the adaptive nervous mechanisms. The second set, having full freedom, was constantly confronted with dangers and difficulties which had to be met and overcome. With the passage of time, the two puppies raised in the natural environment exhibited certain features of the strong equilibrated lively type, while on the other hand, the puppies raised in the kennel displayed, on being released from confinement, certain characteristics of the weak inhibitory type. For example, transmarginal or protective inhibition, in the form of passive-defensive reactions, set in as soon as they were confronted with new or unusual circumstances, or even when the slightest change took place in the surroundings.

Thus the puppies brought up in natural circumstances had, through meeting powerful stimuli and constantly varying conditions, developed strong nervous systems with high functional limits of the working capacity of the cortical cells and at the same time good balance and mobility of the excitatory and inhibitory processes. The puppies brought up in the kennel had, through living sheltered lives, developed weak nervous systems with low functional working capacity of the cortical cells and at the same time inertia of the excitatory and inhibitory processes.

This and other experiments indicated that the chief influence in the formation of types of higher nervous activity is the environment in which the individual development of the animals

takes place. Thus there is variability of nervous type under the influence of changed conditions and training.

2. *Experimental Neuroses: First Stage*

In a series of experiments conducted by Pavlov's laboratory between 1922 and 1925, it was found that it was possible to induce nervous breakdowns in the two extreme types of dogs, the weak inhibitory ones and the strong excitable ones, by means of either powerful or conflicting stimuli. This was the first stage of the work on experimental neuroses. Two experiments will indicate the nature of the work.

The first experiment was performed by M. K. Petrova under Pavlov's guidance. Petrova was a woman scientist who later became one of the best known and most accomplished of Pavlov's co-workers. In this experiment she used two dogs belonging to extreme types of nervous system, one weak inhibitory and the other strong excitatory. She first strained the nervous systems by elaborating six conditioned reflexes in which the response was delayed for three minutes. Having thus prepared the ground, she confronted the dogs with a far more difficult task. To a strong electric stimulus, which ordinarily would evoke an unconditioned defensive reaction, the dogs had to develop a conditioned food response such as licking the feeding dish. At first, both dogs accomplished the feat, but with repetition and with the increasing strength of the electric shock both suffered a nervous breakdown. The symptoms, however, differed considerably. In the first dog, the one with the weak inhibitory type of nervous system, all previously elaborated positive conditioned reflexes disappeared and the animal became extremely sleepy. In the second dog, the strong excitable type, all previously elaborated inhibitory reactions were lost and his behavior was highly excited. In each case the condition lasted several months.

Petrova had succeeded in producing experimental neuroses in the dogs by subjecting them to sharp conflicts of the processes of excitation and inhibition. They had to inhibit a hereditary response to a pain stimulus, and at the same time to develop a conditioned feeding response to that same pain stimulus. The resulting strain was too great for the cortical cells involved and pathological states set in. Particularly interesting is the fact that

identical conditions produced diametrically opposite results in the two dogs: an inhibitory neurosis in the first; an excitatory neurosis in the second.

Of Petrova's experiment Pavlov wrote: "Thus in the two dogs with different types of nervous system, chronic disturbance of the nervous activity, which developed under precisely identical injurious influences, took quite different directions. In the excitable dog the inhibitory process in the cortical cells of the cerebral hemisphere became extremely weakened and almost disappeared. In the quiet dog, usually susceptible to inhibition, it was the excitatory process in the same cells which became extremely weak and almost disappeared. In other words, two quite different types of neurosis were produced."[7] Several months rest brought about a complete cure of the inhibitory neurosis in the quiet dog, but rest alone was insufficient to effect a cure in the second dog. The excitatory neurosis was finally eliminated only by giving rectal injections of 2% potassium bromide solution over a period of ten days.

Another experiment, typical of the first stage of the work on experimental neuroses, was conducted by V. V. Rickman under Pavlov's supervision. Rickman set out to study the effect of unusual and powerful functional influences on higher nervous activity. He used a dog belonging to the weak inhibitory type. Over the space of forty-five seconds the following extraordinary stimuli were simultaneously applied: (1) a loud crackling sound like gunfire; (2) a sudden emergence in front of the dog of a figure in a grotesque mask and fur coat turned inside out; (3) an explosion of gun powder near the stand; (4) a special swinging platform mounted on the stand on which the dog was placed. The reaction of the dog was immediate and drastic. He started, rushed forward and then suddenly became completely rigid, limbs extended, head thrown back, eyes wide open, all muscles strained and breathing deranged. Underlying this behavior was a pathological state of the higher nervous processes in the form of a general inhibition arising in the cortex and rapidly irradiating as far as the mid-brain. Accompanying this transmarginal or protective inhibition there was a complete disappearance of all conditioned and unconditioned food reflexes. The overwhelming predominance of inhibition in the higher parts of the nervous

system lasted for two weeks, showing only slight fluctuations. Normal nervous functioning, and therefore normal behavior, was restored only after sixteen days of rest. But when any one of the components of the original combination of excessive stimuli was applied, the pathological disturbances reappeared.

Here was an inhibitory neurosis produced, not by conflicts, but by overpowering stimuli. It was an experimental nervous breakdown induced in the laboratory. However, six months later, as a result of the great flood and hurricane in Leningrad, September 23, 1924, Rickman's weak type dog again developed an inhibitory breakdown, this time far more persistent. Here was a neurosis produced under natural conditions, and it was cured only after eight months of rest treatment.

The Petrova and Rickman experiments were only two of many generally similar ones performed in the Pavlov laboratory between 1922 and 1925. In this first stage of work on experimental nervous breakdowns, it appeared that the unbalanced properties of the extreme types, the weak inhibitable and the strong excitable, were indispensable pre-conditions for the development of pathological disturbances of the higher nervous activity. Conversely, it appeared that the strong, equilibrated types were immune to nervous breakdowns. Thus for a time the idea prevailed in the Pavlov laboratory that only the extreme unbalanced type of nervous systems was susceptible to the development of neuroses, and further that the character of the neurosis depended mainly on the type of the animal's nervous system. Experimental facts obtained in the second stage of the work, however, corrected this over-simplification and showed that the picture was far more complex.

3. *Experimental Neuroses: Second Stage*

In the second stage, research was directed chiefly to the investigation of various situations causing nervous breakdowns and the neuroses to which they gave rise. Among the situations experimentally studied were: the administration of excessively powerful stimuli; the elaboration of extremely delicate differentiations among stimuli; the development of a conditioned response to every fourth successive stimulus; a quick and direct transition from an inhibitive stimulus to a positive one; and, finally, the

most important situation, the reshaping of the dynamic stereotype, for example, changing the previously established order of the stimuli. All of the above situations proved difficult for the dogs' nervous systems and very often led to pathological states in the form of experimental neuroses.

A year before his death Pavlov came to the conclusion that all these situations could be classified into three major groups: (1) overstrain of the excitatory process due to powerful external influences, as in the Rickman experiment; (2) overstrain of the inhibitory process due to sharp conflict as in the Petrova experiment, or due to any excessively delicate differentiations such as between an oval and a circle, particularly as the oval comes closer and closer to being a circle; (3) overstrain of the mobility of the nervous processes through abrupt transitions from what was a stimulus for a certain action to reacting to the same stimulus by inhibiting the action. Overstrain of the mobility, or in other words of the capacity of the nervous system to make changes in its accustomed reactions, occurs most often, perhaps, in situations requiring the reshaping of habitual patterns of response, called *dynamic stereotypes* of higher nervous activity.

It will be noted that the causes of functional pathological states, or neuroses, were viewed by Pavlov as involving overstrain of one or another of the three properties of the nervous processes of excitation and inhibition, namely force, equilibrium and mobility. In the natural environment of an animal, these properties are of primary significance since they are concerned with the capacity of the brain, and particularly of the cortex: (1) to endure the unusual and powerful stimuli with which nature from time to time confronts it; (2) to be able to inhibit stimuli and respond to them with equal strength and facility, for nature often presents simultaneous conflicting situations, such as food and danger, at which times survival may depend on the balanced capacities to inhibit one and excite the other; (3) to change patterns of behavior, or dynamic stereotypes, to meet changed environmental conditions, for example, when a dog is moved from the country to the city, or vice versa. When the conditions of life are such as to produce overstrain of any one of the three properties, a functional pathological state ensues.

Experimental neuroses, induced in the laboratory in the second stage of the work, were models of overstrain of the three

properties as they might occur outside the laboratory. It was found that, under selected conditions, neuroses could be induced in the strong equilibrated dogs as well as in the two extreme types of nervous system, although more drastic situations were required to do it. Moreover, under appropriate circumstances, any type of dog can develop any kind of neurosis, although a given type may be more susceptible to one than to another pathological state. Thus the dependence of the *possibility* of breakdown, and of the *character* of the breakdown, on the type of higher nervous activity was no longer held to be absolute, but on the contrary was considered to be highly relative.

It was found that the possibility and the character of breakdown depends for the most part on a combination and interaction of many factors. In addition to the peculiarities of the given type, the contributing factors include: the special features of the situation which caused the breakdown; the character and sequence of the difficult tasks placed before the animal; its previous life experience; the general state of its health, and its age. In any case, the susceptibility of dogs to nervous breakdowns of one kind or another was conclusively found not to depend on type alone.

As the work progressed the tendency was to discover greater and greater diversity of symptoms, or complexes of symptoms known as *syndromes.* One such discovery concerned the so-called *phasic states* or *hypnotic phases.*

Under the prolonged action of weak and monotonous stimuli dogs often fell asleep on the experimental stand. At such times it was possible to observe a number of transitional phases between wakefulness and sleep. Many phases were differentiated, but Pavlov singled out three as especially significant. All represent different degrees of the extension of the inhibitory process as it gradually irradiates over the entire cortex. Each phase has its own peculiar quality. First is the phase of equalization in which all stimuli, weak as well as strong, evoke the same intensity of response. This is contrary to the normal wakeful condition in which strong stimuli evoke strong responses, and weak evoke weak ones. The second phase, as the inhibition moves over the cortex toward complete inhibition or sleep, is called the paradoxical phase. Here, strong stimuli evoke little or no response and weak stimuli alone act. The third and final phase stressed by Pav-

lov is the ultraparadoxical in which previously inhibited stimuli have a positive effect. Pavlov called these intermediate states, *hypnotic phases,* since he conceived of hypnosis as partial inhibition of the cerebral cortex in contradistinction to full inhibition or sleep.

In a number of the experimentally induced neuroses, the symptoms included one or more of these hypnotic phases. But in the pathological state, an hypnotic phase, instead of lasting only a fraction of time and then being immediately followed by the next phase in the transition to sleep, as is the case in the healthy cortex, becomes frozen and may last hours, days or weeks

The discovery of the pathological hypnotic phases led to a considerable revision of the original idea, current in the first stage of the work, that there are only two general forms of neuroses, inhibitory and excitatory. For it was now found that excitatory neuroses are often accompanied by one or another of the hypnotic phases. Since the pathological hypnotic phases are inhibitory phenomena, this meant that in such a case there is not an exclusively excitatory neurosis but rather a *mixed* neurosis.

It was found, likewise, that the inhibitory neuroses, in which the hypnotic phases were discovered to be quite characteristic, were in fact also often mixed neuroses, since general motor excitation frequently accompanies them. Consequently, the sharp line that had originally been drawn between excitatory and inhibitory neuroses was to a large extent erased.

A further reason for this obliteration of the line between the two kinds of neuroses was added when it was discovered that there sometimes takes place an abrupt transition from an excitatory neurosis to an inhibitory neurosis, including the hypnotic phases. This gave rise to the concept of circular neuroses, or cyclical neurotic states.

Thus in the second stage of the work on experimental neuroses a considerable broadening and differentiation of the theory took place. As new facts were discovered, new generalizations were required to account for them. The result, as we have seen, is a highly complex and fluid picture of the functional pathological states of the higher nervous activity of dogs. As in all Pavlov's work, however, there is a relatively simple skeletal structure underlying the complexity of detail. If we keep in mind the three essential properties of cortical activity—force, equilibrium

and mobility—and remember that all functional dislocations are the result of the overstrain of one or another of these properties, we will have a theoretical framework for understanding the complex elaborations. For healthy functioning and effective adaptation during its lifetime, the animal must be able to do three things: first, it must be able to withstand the inevitable shocks it encounters in the course of living, that is, its nervous system must have the property of *force* or endurance of the cortical cells; second, it must be able, equally well, to withhold or to release habitual forms of behavior, depending on the immediate external circumstances, that is, its nervous system must have the property of *equilibrium* or equal development of inhibition and excitation; third, the animal, if it is to survive, must be able to make thoroughgoing changes in its habitual patterns of behavior, to meet basic changes in the conditions of its life, its nervous system must have the property of *mobility* or changeability. Obviously, nature is powerful enough, and complex enough, to confront the nervous systems of animals with drastic situations which may exceed the bounds of their capacity to *endure,* to *maintain balance* and to *change.* The result of such overstrain is a nervous breakdown, and the kind of breakdown depends primarily on which property has been so overstrained. Thus while the details are extraordinarily complex, the essential concept is just as extraordinarily simple and logical.

In the third and final stage of Pavlov's work on experimental neuroses, research was concentrated on pathological changes resulting from overstrain of the property of mobility. Experiments in this connection were performed during the closing few years of his life and grew out of problems arising in the clinic. Hence we will deal with them more fully when we come to his work with psychiatric patients.

4. *Experimental Neuroses: Third Stage*

Whereas in the first two stages Pavlov's laboratory had been concerned primarily with experiments in which the whole cerebral cortex was made pathological, in the third stage attention was concentrated on local disturbances. It was found possible to cause, in Pavlov's words, "an entirely isolated area of the cortex to become ill." In particular, overstrain of the property of mobility, when the animal is confronted with a situation which

requires abrupt changes in its patterns of behavior, in its dynamic stereotypes, can produce "isolated pathological points" in certain parts of the cortex. Such isolated points or areas are not literally spatial designations, such as localized groups of cortical cells, but refer, rather, to functional dynamic structures such as the various analyzers, auditory, visual, motor, etc., the cells of which are both concentrated in a nucleus and scattered over wide areas of the cortex.

The experiments concerning so-called isolated pathological points, induced through overstrain of the property of mobility, led to the discovery of two additional mechanisms of functional disturbances of the brain: *pathological inertness* and *pathological lability*. Pathological inertness refers to a state in which certain conditioned reflexes become frozen as it were. They cannot be changed or extinguished, and thus lead to mechanical repetition of responses. Pathological lability is the opposite state, one in which certain conditioned reflexes become completely fluid. They cannot be fixed, but are constantly changing and are highly unstable, leading to chaotic behavior. In cases of isolated pathological points, there is a tendency usually for the disturbance, sooner or later, to spread to other parts of the cortex or to other dynamic structures. Thus it was found that local disturbances often lead to more general disorders of the brain.

We will find later on that Pavlov considered certain of the experimentally induced cases of pathological inertness and pathological lability as rough and simplified models of a number of the syndromes of various human neuroses and psychoses.

Throughout all three stages of the work on functional disorders of the brain, Pavlov and his co-workers observed that experimental neuroses very often led to distinct disturbances of vegetative functions, those concerned with growth and nutrition. In addition to such relatively slight functional changes as labored breathing and abundant salivation, there were various skin diseases, particularly eczema, loss of hair, ulcers, and disturbances of the functioning of internal organs. This is not surprising, for the cortical cells are concerned not only with the relation of the animal to the external environment, but also regulate and coordinate the functioning of the entire internal environment of the organism. Since any disturbance tends to spread over wide areas of the cortex, it is understandable that a nervous breakdown

almost inevitably involves disturbances in the body as a whole. Overstrain of one or another of the three properties of the higher nervous activity leading to some form of neurosis or psychosis, leads also to illness of the body. At the same time, it was found that elimination of the neurosis or psychosis, through rest or bromides or both, as a rule led to the elimination of the somatic disturbances.

So far in the discussion of Pavlov's work on functional disturbances of higher nervous activity, we have dealt solely with experimental neuroses caused by noxious agents acting from outside the animal, namely, difficult experimental tasks and severe external conditions. There is, however, a whole other area, with which we can deal only very briefly here. In addition to *external* causes of neuroses, Pavlov's laboratory investigated *internal* causes. Disturbances of the functioning of higher parts of the brain were found to be caused also by disturbances in the internal medium of the organism, in the functioning of the internal organs, and in the activity of the vegetative and endocrine systems. This is not to be confused with the vegetative and somatic disturbances *resulting* from externally induced neuroses, as described above. Here we are concerned with vegetative, glandular and somatic disturbances which *cause* neuroses. Thus neuroses can cause illness of the body, and illness of the body can cause neuroses. It is the latter with which we are now concerned.

The fact that the cerebral cortex is highly reactive to vegetative-endocrine changes was first demonstrated, not in pathological conditions, but in normal, healthy physiological functioning. For example, in the period of heat or in the period of pregnancy and lactation, there are marked functional changes of the higher nervous activity of dogs, including: decline and instability of conditioned reflexes; phenomena of drowsiness; and changes of cortical excitability with a predominance of diffused inhibition. Such effects of glandular and vegetative functions are by no means pathological. They are normal changes in the higher nervous processes brought about by changes taking place in the course of reproduction. When the periods of heat, pregnancy and lactation are over, the cortical processes return to their former state.

Pathological disturbances of the higher nervous activity were

found to be caused by endocrine or glandular changes and disorders and by certain intoxications and infections of the organism.

Experimental investigations of the effect on cortical processes of changes and disorders in the secretions of various glands were conducted by a number of workers in Pavlov's laboratory. They studied the effect of castration and of changes induced in the functioning of the thyroid, the parathyroid, the pituitary and the adrenal glands. In every case, it was found that the endocrine disturbances, disturbances of the internal secretion of glands, led to considerable changes in the work of the higher parts of the brain. For example, immediately following castration the normal relations in the animal's nervous system were greatly disrupted. Changes took place in all three properties, the force, equilibrium and mobility of the excitatory and inhibitory processes. Depending on the type, age, health, etc., of the dog, these disturbances lasted a certain length of time and then began to return to normal. In most cases it was possible to attain full recovery of the higher nervous activity in castrated dogs, but afterwards their nervous systems revealed a heightened susceptibility to functional disorders. Experimental neuroses were developed in them with relative ease. Because of this latter fact, castrated dogs, after recovery, were commonly used for experiments on the development and cure of neuroses. Thus the removal of the sex glands leads to temporary disturbances of cortical activity, and to lasting susceptibility to neuroses. Extirpation of any one of the other glands, or the increase or decrease of their secretions, led to such disturbances of the cortical processes as rapidly irradiating protective inhibition, hypnotic phases, lowering or loss of conditioned and unconditioned reflexes, catalepsy, etc. The specific form of the disturbance depended on the type, age, health and life experience of the dog, as well as on which of the glands was involved in the experiment.

Work on these artificially induced endocrine disturbances is still in progress in the Soviet Union, and no specific conclusions can as yet be drawn with finality. Only the general conclusion, that endocrine changes may produce functional disturbances of the higher nervous processes, is beyond question. The one exception is the castration of dogs, which has been thoroughly investigated.

In the early thirties, M. K. Petrova and others performed experiments in the Pavlov laboratory demonstrating that various intoxications, or poisonings, can lead to pathological states of the cerebral cortex. This was first discovered when it was found that bromides, far from being always conducive to improvement of neuroses, sometimes make them worse. Thus bromides have a toxic effect on certain dogs, particularly the weak type. Upon further and systematic investigation, it was found that many toxic agents produce pathological changes in the cortex. For example, excessive doses of calcium chloride lead to a pathological predominance of the excitatory process ending in cortical exhaustion and consequent transmarginal or protective inhibition and hypnotic phases.

Petrova made a thorough experimental study of chronic alcohol intoxication in dogs and its effect on the functioning of the higher parts of the brain. She found that the first effect of canine alcoholism is the gradual weakening of the inhibitory process, and following that, the excitatory process, too, begins little by little to weaken. Next, hypnotic phasic states set in, one succeeding the other, indicating that irradiating protective inhibition is under way. Since, however, the intoxication continued, the spreading protective inhibition was checked, and states of pathological lability (instability) and of pathological inertness, immobility) alternated, accompanied by unusual behavior indicating something resembling phobias and hallucinations.

Experiments with other toxic agents, such as sodium cyanide, carbon oxide and bulbocapnine, as well as with toxic doses of such agents as adrenalin and phenamine, showed that certain intoxications produce a variety of pathological disturbances in the cortex accompanied by neurotic and even psychotic, forms of behavior.

We have now followed the story, in a highly abbreviated and digested form, of Pavlov's discovery of the various nervous mechanisms underlying experimentally induced neurotic behavior in dogs. We have seen how the work conducted in the Pavlov laboratory developed from its simplified beginnings, through several stages, to the mature elaboration of a many-sided approach to functional diseases of the cerebral cortex. New facts, constantly emerging in the course of experimentation, led Pavlov and his colleagues to the conclusion that neuroses can be

brought into being by both external and internal causes, by situations arising in the surrounding world and within the organism. And further, neuroses can, and often do, give rise to pathological conditions of the body. These conclusions, however, taken by themselves, tend to obscure Pavlov's real achievement which lies in the detailed discoveries of precisely how the various neurotic syndromes are expressions of definite disturbances of higher nervous activity. He not only discovered and demonstrated that neurotic behavior in dogs takes place solely on the basis of patho-physiological changes in the higher parts of the brain, but, in addition, he worked out in profuse detail how particular disturbances arise and develop.

It is one thing to be able to induce a rich variety of experimental neuroses, and another to cure them. Pavlov was even more interested in the latter aspect. We turn now to the question of experimental therapies investigated in his laboratory.

5. *Experimental Therapies*

The search for effective forms of treatment was carried forward throughout all three stages of the investigation of experimental neuroses. As a matter of practical necessity, as well as scientific research, cures had to be sought in the course of inducing pathological states, since available dogs were limited. Thus, whenever a neurosis was formed, the experimenter tried at once to eliminate it. As a result of fifteen years of such attempts, three general forms of treatment were developed: *rest and training; medicaments;* and *sleep.*

Treatment by rest and training included a number of therapeutic measures. In some cases it was possible to cure the pathological condition by relieving and renovating the procedures of the experiment. For example, those stimuli responsible for the overstrain were eliminated in order to give as much rest as possible to the affected area of the cortex. In other cases, it was found necessary to conduct experiments only every two or three days, rather than every day, as was the usual practice. If the rest thus afforded proved insufficient, the dog was given a complete respite from experimentation for weeks or months, according to the need. In cases where the neurosis had been induced by an extremely difficult task which overstrained the nervous processes, it was found that training was a very effective form of

treatment. In such cases, the dog's nervous system was first confronted with relatively simple tasks and then gradually with increasingly more difficult ones. This training often led, slowly but surely, to the accomplishment of the task which had originally overstrained the cortical processes. The effectiveness of all these measures depended on a number of factors in addition to the specific character of the neurosis itself: type of higher nervous activity, general health, age, etc. It follows that the problem of prescribing treatment is a highly complex matter. What will eliminate a given neurosis in one dog, will not necessarily cure the same kind in another.

When rest alone proved inadequate, it was combined with the use of medicaments, in the first place bromides. Solutions of sodium bromide, and to a lesser extent potassium bromide, were employed in the treatment of experimental neuroses from the very beginning and thus were thoroughly investigated. It was found that the action of bromide consists in both intensification of the inhibitory process and concentration of the excitatory process. The effect of this double action is to establish proper dynamic balance of excitation and inhibition in the cortex. Dosage depends primarily on the type of nervous system, but the factors of age and state of health are also important. In general, it was found that the weaker the type of nervous system, the smaller should be the dose of bromide. Bromide combined with rest proved one of the most effective therapeutic remedies for experimentally induced functional disturbances of the higher nervous activity.

In the more severe cases, however, particularly in local disturbances, the combination of bromide with rest was ineffective, and new medicaments were tried. One of these was caffeine. It was found that the action of caffeine consists in the intensification of the excitatory process, just as bromide acts to intensify the inhibitory process. But, while caffeine increases the excitatory process, it at the same time tends to exhaust the cortical cells and thus lead to transmarginal-protective inhibition. Only minimal doses would intensify the excitatory processes without leading to exhaustion. Since bromide and caffeine were found to act in more or less opposite ways, the one on the inhibitory and the other on the excitatory processes, Pavlov concluded that the two pharmaceutical agents could be employed in combination to

effect a proper balance of excitation and inhibition in severe cases. Petrova applied this combination with good results in the treatment of a number of aggravated cases. Here again, the dosage had to be adjusted to specific neuroses, nervous types, ages and states of health. Other medicaments were tried, including calcium chloride, phenamine and sympathomimetin, but as yet tests have proved inconclusive. In all cases in which medicaments were used, they were combined with rest of one kind or another.

Throughout the work on therapeutic methods, rest was found to be indispensable. Its action, evidently, is to relieve the cortical cells from further strain, to leave them in peace, as it were, and thus to allow the metabolic processes to restore them to their normal state and functioning. The most complete form of rest for the cortical cells is sleep, in which protective inhibition has irradiated throughout the cortex and down into the subcortex and mid-brain. Basing herself on Pavlov's theory that sleep is a form of protective inhibition and that protective inhibition is not only protective but also restorative, Petrova investigated the action of artificially induced sleep on experimental neuroses.

She first investigated the therapeutic effect of narcotic sleep. Applying various dosages of veronal, she induced sleep in neurotized dogs, usually lasting six, but sometimes as long as thirteen, days. In every case, sleep therapy contributed significantly to the elimination of both the neurosis and of whatever vegetative disorders had accompanied it, such as ulcers, eczemas and loss of hair. In addition, dogs treated by narcotic sleep were found to be considerably less susceptible to disturbances of their higher nervous activity than they had been in the years prior to their breakdown. In the most severe cases, sleep therapy was applied two or three times, with a week or so interval between applications. The minimal dosage of veronal required to produce deep and prolonged sleep varied according to the nervous type, age and health of the dog. Whatever the individual dosage, veronal was applied twice a day for the duration of the treatment. Petrova reported that narcotic sleep "proved of great benefit to all the dogs without exception, irrespective of the type of nervous system, age and degree of exhaustion."[8]

In addition to narcotic sleep, Petrova employed another form

of sleep therapy which she called "hypnotic sleep." Here she used a combination of mechanical agents including weak, monotonous stimuli, a slowly blinking blue light and weak stimulation of the skin. The result was a deep and prolonged sleep. One advantage of this form of sleep treatment was that there were none of the after effects so common with the use of narcotics. In many instances, hypnotic sleep was used to supplement natural sleep, adding two or three hours of complete rest daily. Thus the protective inhibition was heightened and the cortical cells could restore themselves without being subjected to disturbing stimuli. Very good therapeutic results were obtained by this method, in most cases leading to full recovery.

Although all three forms of treatment, by rest and training, by medicaments and by sleep, proved effective in given cases, much work remains to be done. This is especially true with regard to the fitting of the therapeutic measures to the specifics of kind of cortical disturbance, nervous type, age and state of health. The number of important variable factors involved makes the problem of therapy exceedingly complex. Thus far in the work on therapeutics, the best results have been attained with bromides, with the combination of bromides and caffeine, and with protective-curative inhibition in the form of sleep—narcotic, hypnotic and prolonged natural sleep. For future work, it appears that Pavlov's idea, investigated experimentally by Petrova, of artificially stimulating and intensifying protective inhibition, that is, sleep therapy, holds the greatest promise.

Such are the main outlines of Pavlov's investigation of experimental pathology and experimental therapy of the higher nervous activity in dogs. The next great question is pressing: What significance does this work hold for the pathology and therapy of the higher nervous activity in human beings? In this connection Pavlov wrote, "Thus you see that in the field of pathology our method, the method of objective treatment of the highest phenomena of the nervous activity in animals is fully justified; and the more we use it, the more it is justified. At present we are making, as it seems to me, lawful attempts to apply this same method also to the human higher nervous activity, usually referred to as psychical activity."[9] The next task is to follow these "lawful attempts" in progress toward a scientific psychiatry.

Chapter VI

CASE ANALYSIS OF NEUROSES AND PSYCHOSES

PAVLOV SPENT ONE-THIRD of his life studying the higher nervous processes of dogs as a key to unlock the door to the human brain. In the last years of his long career he applied this vast store of experimentally verified knowledge to cases in the psychiatric clinic. In doing so, he applied the physiological approach to mental illness. This approach has two phases: first, the study of the relevant life history of the patient; and second, the study of changes in his nervous system.

Of the first phase, Pavlov says, "In man it is necessary first to determine exactly where lies the deviation from the normal. But the behavior of the normal is exceedingly varied in different persons. Then one could consider together with the patient, or independently of him, or even against his resistance, among the affairs vital to him, those conditions that have acted immediately or gradually, and with which perhaps the origin of the illness may be justifiably linked. Further, one must know why these conditions and difficulties produce such a result in our patient, when they are without influence on other people. And why does this lead to a certain complex in one patient and to an entirely different one in another patient."[1]

The first phase does not sound too different from analyses made from quite another point of view. The newness lies in its relation to the second phase. In effect the first phase is a search for those external and internal conditions of life which may have been instrumental in producing deviations in the behavior of the patient. Pavlov was always deeply concerned to discover the social and family conditions of the patient, his trade or profession, the conditions in which he was brought up, his education, his past life, the diseases he had had, the emotional shocks or situations of conflict he had experienced. He was concerned with these social and personal conditions, not to

seek out some hidden, suppressed or subconscious motivation which could then be expressed or sublimated and thus somehow be wafted away or adjusted to, but to understand the forces at work on the patient which had played a role in disturbing his higher nervous activity.

The second phase of the new approach to mental illness consists in attempts to discover those deviations in the functioning of the nervous system which underly deviations in behavior. "This (first phase) is only part of the matter," Pavlov says, "if one attempts a complete and final analysis. Of course the deviation in behavior of our patient comes from a change in his nervous system. Who can deny that? Therefore it is necessary to answer this question: how and why do there arise in the given case changes in the normal processes of the nervous system?"

Pavlov believed that he had found, in his work with experimental neuroses in dogs, the basis for an answer to this question: depending on such variables as the type of balance between excitatory and inhibitory processes, age, general health, and life history, the animal finally breaks down under certain fundamental conditions. There are three main circumstances that produce neuroses in animals: overstrain of the excitatory processes; overstrain of the inhibitory processes; or a conflict between both these processes.

He was convinced that this mechanism of neurotic behavior was not simply a peculiarity of the nervous apparatus of dogs, but was an essential physiological phenomenon of the cerebral hemispheres, including those of man. "And so," he says, "what my associates and I have found with our animals are elementary physiological phenomena—the frontier of physiologic analysis (in the present state of knowledge). At the same time it is the prime and most fundamental basis of human neurosis and serves as its true interpretation and understanding."[2]

Pavlov's approach to psychiatry carried forward the cardinal principle inherent in all his work, the dynamic equilibrium between the organism and its environment. The balance between excitation and inhibition, a certain type of which is established during the course of each animal's or each person's life, is the mechanism of this equilibrium. When the equilib-

rium is upset by some big change in the conditions of life, the excessively strong stimuli resulting may, under certain conditions, break down the established balance between the excitatory and inhibitory processes. This nervous breakdown is the functional disorder known as a neurosis, which, of course, has many forms. Neurosis, then, is a result of over-strain of the nervous system when the conditions of life have put too great pressure on it.

Thus the two phases of Pavlov's approach to neurosis form one integrated whole, conditions of life and nervous reactions to them. In man, this whole, this disequilibrium and resulting unbalance of nervous processes, is immensely complex in both aspects. But in essence it can be put into one question. In Pavlov's words it is, "What circumstances in his life are excessively strong for the nervous system in question, where and when has he encountered a conflict intolerable for him, requirements that he become active and requirements that he hold himself back?"[3]

Clearly all of us are faced continually both with situations subjecting us to exceedingly strong stimuli and with situations confronting us with sharply conflicting requirements of activity and inhibition of activity. In most cases we absorb the shock, or struggle through the conflicts, with more or less of a strain on our nervous systems. But in some instances our nervous balance of excitation and inhibition is relatively weak, either from our life history or from temporary weakening through somatic illness or a long series of stresses and strains, in which case we may suffer a breakdown of nervous balance.

Pavlov used this two-phase analytical method in the clinic, and perhaps the best way to introduce his approach to functional mental illness is to follow his analysis of a few concrete cases.

Case of Twenty Years' Sleep

One of the first cases Pavlov undertook to analyze was a case of twenty years' sleep, called "lethargy." It reflects the essence of his theory of neurosis and therefore makes a good starting point.

The patient was a man sixty years old who had lain like a

living corpse in a hospital bed for twenty-two years. During that whole time he never made the least voluntary motion nor uttered a single word. He was fed by a flexible tube inserted into the oesophagus. The digestion of this food was almost the only sign of life, apart from a weak pulse and shallow breathing.

As he approached the age of sixty, however, he began more and more to make voluntary movements. Finally he could get out of bed without help, eat by himself, and talk freely and quite rationally. He said of his former corpse-like state that he understood everything around him, could recognize doctors, nurses, relatives and friends, but that he felt such an extreme and insuperable heaviness in his muscles that he could not possibly move them. All the time he felt as though he could hardly breathe, let alone talk.

"How," asked Pavlov, "are the described conditions (of this case) to be characterized from the physiological point of view?"[4]

Of his approach to this case as well as to others, Pavlov wrote, "My way of looking at the psychiatric material was however greatly different from the usual point of view adopted by the specialists. Owing to many previous years of experience in the laboratory I reasoned on a purely physiological basis. As I always tried to explain to myself in physiological conceptions and terms, the psychic activity of lunatics, I did not experience great difficulty if I concentrated not on the details of the subjective state, but on the principle features and phenomena of the pathological state of the insane."

Some of the psychiatrists concerned with the case held that the stupor-like state of the patient was the consequence of some strong emotion. But Pavlov felt that this kind of speculation was not helpful, that it was trying to find the cause of the symptoms without knowing its mechanism. It may be that strong emotion was a contributing cause. To say that, however, is to lead nowhere. The fact is that there has been a disturbance of the higher nervous processes, whatever the cause. To discover the nature of this disturbance, Pavlov concentrated on the pathological symptoms.

The chief symptom was the complete absence of voluntary movement, while other functions were relatively unimpaired.

Now the central organs of voluntary motions are certain masses of cells in the cerebral hemispheres. Since the patient could see, hear, and understand what was going on about him, the other specified cells of the cortex were unimpaired. Pavlov concludes that the patient suffered from "the exclusion of the activity of only the motor region of the cerebral hemispheres."[5] Thus the *mechanism* of the stupor-like state was concerned with to see in these symptoms "a single general mechanism"?

In answer, Pavlov points to known similar cases in man and animal. "A strictly limited suppression of the motor area of the cortex of the cerebral hemispheres is known also in other human or animal conditions." For example, *hypnosis.* A person under certain types of hypnosis understands all that he is told but has no voluntary control over his skeletal muscles, i.e., over his movements. Pavlov had done considerable experimental work on the nervous mechanism underlying the phenomenon of hypnosis. His conclusion was that one mechanism of hypnosis is the isolated *inhibition* of the motor area of the cerebral hemispheres. By scientific deduction, therefore, he says of the case of twenty years' sleep that "we have enough evidence to affirm the existence of a concentrated and isolated inhibition of the motor cortex of the cerebrum, as a result of the cause which brought about the disease." His final diagnosis of the case was: "If it is granted that sleep and hypnosis are a kind of special inhibition, the patient would present an example of chronic partial sleep or hypnosis."[6]

The cause of this isolated inhibition of the motor region could, he said, be one of several. It could be an exhaustion of the motor elements of the cortex due to the part played by them in the work producing the exhaustion; or it could be the result of reflex influences which may have injuriously affected the elements of the cortex.

But whatever the cause, Pavlov felt that the recovery of the patient at the onset of "old age," was strong indication that he was right in his diagnosis. For there is, he says, a sharp "decline of the inhibitory processes" in old age, to be seen "in senile talkativeness, eccentricity, and, in extreme cases, imbecility."[7] Thus there would also be a decline in the isolated inhibition of the motor area of the cortex, leading to the re-

covery of voluntary motion, as in the patient when he was nearing the age of sixty.

In this case the therapy was provided by nature through the onset of old age. Medicine, however, no less than the science of genetics, cannot wait for such favors but must, as Michurin said, "wrest them from nature." Later on we will see that Pavlov's approach to neuroses through the discovery of the nervous processes involved in the illness leads to *intervention* in the course of the disease in order to restore the organism to health. In the above case, therapy would have to be designed to counteract, check and reverse the process of concentrated inhibition in the motor areas of the cortex.

Pavlov's analysis of the case of the twenty years' sleep indicates at least two aspects of his approach to functional mental illness: one, that pathological mental functioning takes place on the basis of a pathological functioning of the higher nervous processes; and, two, that therefore the psychiatrist must have, as his primary task, the discovery of the specific nervous process which has been disturbed by certain life conditions of the patient. Only then can diagnosis and therapy be made and prescribed on a strictly scientific basis.

The case also indicates Pavlov's conception of neurosis. Neurosis, for him, is not a vague catch-all name for emotional problems and contradictory thinking. It is a chronic disturbance of the higher nervous processes—a deviation from the normal work of the hemispheres, whatever the immediate cause. It is a *functional* condition not an organic one; i.e., it is not caused by damage to, or disease of the hemispheres. Being functional, Pavlov held that theoretically neuroses were entirely curable. As a matter of fact, his analysis of neurosis was in part based on the concept of protective inhibition—sleep and the phases and degrees of hypnosis or partial sleep. Various forms of irradiating or concentrated protective inhibition occur in the cells of the hemispheres, the most reactive cells in the human organism, when, for example, they are subjected to emotionally strong stimuli exceeding the bounds of endurance; or when there is a too sharp clash of excitatory and inhibitory stimuli—to act and not to act in a certain way. In such instances, the cells may be protected from organic damage by inhibition, a block to excitation. This inhibi-

tion may eventually of itself lead, through rest of the cells, to restoration of normal functioning, a balance of excitation and inhibition.

Pavlov's analysis of schizophrenia illustrates both the approach to, and concept of, functional mental illness.

Cases of Schizophrenia

The first cases that Pavlov analyzed in the clinic attached to his laboratories were patients suffering from different forms of schizophrenia. In a paper written in 1930, he reported on his findings.

Here again he concentrated on the pathological symptoms of behavior rather than the details of the subjective psychic phenomena. "My attention rested", he says, "particularly on the symptoms of apathy, dullness, immobility and stereotyped movements, and on the other hand, playfulness, unconventionality and in general childish behavior appropriate to patients with such illnesses (hebephrenia and catatonia)."[8] Is it possible to see in these symptoms "a single general mechanism"?

For an answer, he turns to the science of the conditioned reflex. In his laboratory he had established two aspects of higher nervous activity. On the one hand, the process of excitation, the formation of temporary connections between various stimuli from external objects and muscular and glandular responses, is constantly participating in the life activities of the organism during the waking state. On the other hand, inhibition, the blocking of the excitation through resistance, is, as he puts it, "ever appearing in the role of guardian of the most reactive cells of the organisms, the cortical cells of the cerebral hemispheres, protecting them against extraordinary tension of their activity when they must meet with very strong excitations, securing for them necessary rest, after the usual daily work, in the form of sleep."

He had also established that sleep is a form of inhibition spreading over all the hemispheres, while, in the transitions between the waking state and complete sleep there are intermediate states called hypnotic phases. It is the phases of partial sleep or hypnosis which Pavlov found to be so important in the objective analysis of schizophrenia and certain other forms of neuroses and psychoses. What are these "hypnotic phases" then? "These

phases," he says, "appear to us, on the one hand, as different degrees of the extent of inhibition in the areas of the hemispheres themselves and also in different parts of the brain; and, on the other hand, as different degrees of intensity of inhibition in the form of varying depths of inhibition at one and the same time."

All the symptoms of schizophrenia are found in one or another of the various phases of hypnosis—like apathy, dullness, immobility, playfulness. From this, Pavlov draws his conclusion: "Studying the aforementioned schizophrenia symptoms I came to the conclusion that they are the expression of a chronic hypnotic state."[9] More evidence, however, than coincidence of the general symptoms is required. So Pavlov applied his analysis to the secondary and detailed symptoms.

He noted that the apathy and dullness of certain schizophrenic patients expressed themselves mainly in failure to react to questions, as if there were complete insensitivity. But he found that if the patient was placed in a quiet room and if the questions were put to him in a very soft voice, he answered them. Here again is a characteristic hypnotic phenomenon. It is a symptom met with in the so-called paradoxical phase of hypnosis, in which the organism has lost all reactions to strong stimuli, and reacts only to weak ones.

Further evidence for Pavlov's thesis of the connection between schizophrenia and the phases of hypnosis is the phenomenon of negativism observed in the patients. They react oppositely to their accustomed normal conditioning. When, for example, food is offered they will not eat, but when it is taken away they want it. The same is true of a certain phase of hypnosis.

Stereotypy, continued repetition of the words or the movements of the one to whom he is giving attention, is a very common symptom in schizophrenia, called echolalia and echopraxia. It is likewise a familiar phenomenon in a hypnotized normal person, occuring most frequently in hypnosis produced by "passes." Thus again Pavlov's thesis is fortified.

Both catalepsy (the continued maintenance by the patient of any position the body is put in, either by another person or by himself), as well as catatonia (a tense state of the muscles which resists any change in a given position of any part of the body), are at the same time symptoms of schizophrenia and phenomena of hypnosis.

Finally, in corroboration of his contention, Pavlov cites the symptoms of playfulness, childishness, foolishness, and capricious and aggressive excitement, found in some forms of schizophrenia. These symptoms are found also in various forms of hypnosis and in alcoholic intoxication. "In these cases," he says, "there is reason to think they are the result of a beginning general inhibition of the cerebral hemispheres, as a consequence of which the neighboring subcortex is . . . freed from its usual control, the constant inhibition from the hemispheres during the waking state. . . . Childishness and foolishness, in inebriation, hypnosis and certain types of schizophrenia, are, according to Pavlov, due to the blocking of cortical control of the lower nervous centers.

From all this evidence Pavlov concludes that his thesis is correct: "After all the above cases one can hardly doubt that schizophrenia in certain variations and phases actually represents chronic hypnosis."[10]

There is recent evidence tending to support Pavlov's theory that the symptoms of certain forms of schizophrenia are caused by a partial hypnosis or inhibition of the cerebral cortex. Dr. Wagner Bridger and Dr. W. Horsley Gantt, using the Pavlovian approach at Johns Hopkins University, discovered that mescaline, a drug that produces experimental mental illness in human beings, causes an inhibition of the cerebral cortex accompanied by a dissociation of the usually highly coordinated three systems of higher nervous activity, the unconditioned reflexes and the first and second signalling systems.[11]

The discovery by Pavlov that patho-physiological *mechanisms* underly *functional* mental illness is a tremendous advance of science. Prior to this discovery, functional mental illnesses were thought for the most part to be "purely mental," that is, that they had no physiological mechanism in a pathologic condition. This was presumed to be the case because the only physiological causes of mental illness were thought to be organic conditions, that is, actual injury to cells.

Hence, prior to the discovery of the patho-physiology of functional mental illness, the field was wide open for all manner of speculative and subjective theories of neuroses—the Freudian, Adlerian and others. The unconscious in revolt against the restrictions of the conscious in one form or another was a common

theory. These theories, whatever their specific form, tended to look, not for disturbed nervous processes, but for conflicting emotions and drives, ids and super-egos, as the mechanism of mental illness. Sharply conflicting emotions and situations can be powerful contributing causes of mental illness, but cannot constitute its mechanism, according to Pavlov.

These theories, developed independently of the sciences of higher nervous processes, conceived of neurosis in terms of purely mental conflicts. Two things followed: first, since no sharp line was drawn between emotional conflicts in general, and so-called pathological conflicts, neurosis was viewed as almost universal—"everybody is neurotic to some degree." Second, the therapy for "neurosis" proceeded along purely psychic lines—digging into the emotions and thoughts, conscious and "unconscious," with the idea that recognition of conflict somehow leads to resolution or at least to adjustment.

Pavlov, on the other hand, viewed mental illness of the functional type as a definite breakdown of nervous processes underlying the mental activity which may have contributed to its production. Therapy, for him, was concerned primarily with the restoration of healthy nervous functioning. The further task of insuring that there would be no return of the pathological condition had to be carried out also. This involved changes in living conditions, consciousness and behavior so that the nervous system would not again be subjected to the same overpowering stimuli and conflicts.

The Pavlovian approach to psychiatry brings it back into the fold of medicine. It puts the emphasis not on the content of the mental symptoms but on the patho-physiological mechanism underlying them. The fact that these mechanisms were not known had tended to focus the attention of psychiatrists on the subjective symptoms, the particular delusions, obsessions and dreams, of the patient. Analysis of mental symptoms became a major element in psychiatry, particularly under the influence of psychoanalysis which is based on this approach. As a matter of fact, one could make a good case to the effect that psychoanalysis arose in the first place on the insecure foundation of the failure of psychiatry to discover the patho-physiological mechanism underlying the subjective mental symptoms.

The history of medicine is full of instances where concern

with mental symptoms and their analysis predominated until such a time as the patho-physiological mechanism was discovered. A good example is neurosyphilis. This disease produces hallucinations, delusions, and other similar symptoms. Before the mechanism of the disease was discovered, patients with syphilis of the brain were often treated with psychotherapy. Great emphasis was put on analysis of what happened in the patient's childhood which could account for the kind of hallucinations he had—what childhood experiences did he have, for example, which would now make him think he was Napoleon. When the cause of the disease was found to be the harmful spirochete microbe, all emphasis was placed on curing the illness with drugs such as penicillin. Nobody was any longer interested in analyzing the subjective symptoms, in discovering why one patient thought he was Napoleon and another that he was Shakespeare. The content of the mental symptoms was, to be sure, determined in part by the life experiences of the patient, but the mechanism of the disease was the patho-physiological state caused by the spirochete. The therapy had then to be directed at the elimination of this state.

Cases of Clinical Hysteria

In his analysis of clinical hysteria, Pavlov deals with the patho-physiology not only of a functional illness but of one which is largely psychogenic, a mental reaction to social conditions. Hysteria is produced primarily by emotional shocks and conflicts. Here is a test for the conditioned reflex method: Can the physiological approach deal effectively with psychogenic forms of mental illness? Pavlov's answer was a confident "yes."

According to him, hysteria is a psychical disorder resulting from exhaustion of the brain, especially of the cerebral hemispheres. In the healthy nervous system, the cerebral cortex, as the highest organ of correlation of the organism with the environment, has a restraining effect on the other parts of the brain. The second signalling system, speech signals, as the highest function of the hemispheres in human beings, usually predominates, regulates and controls the other parts of the brain in the waking state. Hence, in cases of hysteria, with the strained and weakened cerebral activity and consequent protective inhibition spreading

over it, the first system of signals is freed of control by the second, producing, as a result, the extraordinary fantasy and imaginative state characteristic of some forms of hysteria. "This second system of signalization and its organ, the very last attainment in the evolutionary process," Pavlov says, "should be particularly fragile, supported in the first instance by overflowing inhibition, once it has arisen in the cerebral hemispheres in the primary degrees of hypnosis. Then instead of the usually predominant (in the waking state) function of the second signalling system, there arises the activity of the first system, primarily and more stably, as fantasies and day dreaming, but further and more definitely as sleep, dreaming and drowsiness, freed from the regulating influence of the second system. Hence the chaotic character of this activity depending chiefly upon the emotional influence of the sub-cortex."

In the healthy waking state there is a united and equally reciprocating activity of the first and second systems, but under regulation of the speech system. On the other hand, "in hysteria," Pavlov says, "we have a continued separation of these systems with a marked disorganization of the natural and lawful correlations."[12] The disorganization between the two systems in the hysterical patient is somewhat similar to the condition of people who are under the influence of narcotics, that is, the hemispheres are under partial inhibition, or hypnosis. In the hysteric, there is acute restraint of the cortex due to intolerably strong stimulations. These ultramarginal stimulations provoke a protective inhibition in the cortex which may prevent injury to the cells. Thus "the hysterical patient often can and must be considered under the ordinary circumstances of life as chronically hypnotized to a certain degree." To his weak cortex even usual stimuli of daily life have become too strong and thus evoke inhibition.

This weakened condition in the first place is produced by some overpowering experience such as war, or other experiences involving exceedingly strong stimulation or exceptionally sharp conflict. Thus Pavlov says, "Not only the threat of war but many other dangers for life (fire, railroad wrecks, etc.), the countless blows of fate as the loss of loved ones, disappointment in love and other vicissitudes of life, economic reversals and the devastation of one's beliefs and faith, etc., and in general hard living conditions: an unhappy marriage, the struggle with poverty, the destruction of the feeling of self-respect, etc. evokes at once or

finally in the weak person the strongest reaction with various abnormalities in the form of somatic symptoms."

What may happen to people with weakened nervous systems under the buffetings and struggles in a hostile society, Pavlov shows in his analysis of war neurosis, a form of hysteria. War creates the fear impulse. Fear represents certain physiological symptoms—like heartbeat, blood pressure, adrenalin, muscular tension—which in the strong nervous system are quickly dissipated. But in the weakened system the symptoms last for some time. They may disappear in time, but if the system is weak enough, precisely because of this weakness the mechanism of the symptoms is reinforced:

"The symptoms of fear become connected, associated with security to life by the law of conditioned reflexes. Hence the existence of these symptoms is invested with a positive emotional coloring and repeatedly reproduced. Then according to the law of irradiation and summation from the cortex they reinforce and intensify the lower centers of reflex symptoms of fear (blood pressure, heartbeat, etc.) on the one hand, and on the other hand being emotionally charged, in the weak cortex accompanied by strong negative induction, they thus exclude the influence of other representations which might oppose (them)."

Thus the fear is continually strengthened while other emotions and ideas, which might counteract them, are excluded, leading to an ever deepening concentration. All other stimuli either become part of the fear complex or are excluded by inhibition. Finally, the hysterical patient gets a stake in his illness. To protect himself from situations with which he cannot cope, he clings to his illness. "Hence," says Pavlov, "the flight, the will to be sick as a most characteristic feature of hysteria."[13] Again the will to be sick, itself, reinforces the symptoms of fear. Here, indeed, is a vicious circle. Even further, the illness becomes a means of obtaining the respect, attention and good will that his weakened condition and fear fixation do not normally command. What is true of the war neurosis can be true of the extreme weak nervous system under the other experiences and situations Pavlov mentioned above.

Autosuggestion is another common phenomenon among hysterical patients. "Any slight feeling," Pavlov says, "of indisposition or unusual difficulty in any organic function is accompanied

in the hysteric by the emotion of fear of a serious illness, and this is enough, by the above mechanism (the mechanism of war neurosis), not only to support but to intensify them to an extreme degree, making of the subject an invalid."[14]

Neither in the war neurosis nor in the case of hypochondria is it a matter of "intentional simulation of symptoms." Rather, the cortex, weakened under life's impact, fails to function normally. Thus it is a matter of the breakdown of higher nervous functioning. "It is," Pavlov says, "an example of fatalistic physiological relations." The cure is primarily a matter of restoration of normal higher nervous functioning. Pavlov had considerable success in restoring this functioning by use of bromides and various forms of sleep therapy—protective inhibition, heightened and protracted, to restore the balance of excitation and inhibition in the delicate cerebral cells. At the time Pavlov wrote, bromides had proven to be the most effective drug. But since then new and better drugs have been discovered, but even now the final cure is not as yet achieved.

Cases of Obsession and Paranoia

In 1934, two years before his death, Pavlov attempted to analyze several cases of obsession and paranoia. In these analyses, he demonstrates his approach in its most mature form. One of the cases he presents is a young woman suffering from an obsession. She was modest, businesslike and highly moral in her social relations. She was of the weak type of nervous system. Shortly after attaining maturity, she was strongly attracted by a man, but her ethical and religious background prevented the realization of this attachment. The resulting clash between excitation and inhibition led to an obsessive conception that her sexual attachment was crudely reflected in her face. She avoided going out into the street since she thought people looked at her face and laughed. So far, these ideas are imaginary but still within the realm of possibility. There followed, however, a jump to the fantastic. Subsequent to a conversation with a friend about the temptation of Eve by the serpent in the Garden of Eden, she developed the unexpected and irresistible idea and sensation that a serpent lived inside her. It moved continually and sometimes its head seemed to rise in her throat. She could literally feel all

this. These were the behavioral and verbalized symptoms. What was the nervous disturbance that underlay them?

The obsessive conception that her sexual attachment showed in her face is, according to Pavlov, based on the phenomenon of pathological inertness. It is an "inert idea," meaning that it is constantly present and that other ideas either become connected with it or are blocked. Thus any ideas, which might counteract the obsessive idea, are inhibited. The higher nervous mechanism underlying the inert idea is the clash of excitation and inhibition; the inhibitory process of the nerve cells involved has been weakened and the excitatory has become dominant. Other excitations are blocked and excitation becomes stabilized and localized around one set of cells, leading to abnormal inertness of their excitatory process.

Pathological inertness, according to Pavlov, can occur in various areas of the cortex. If it occurs in the motor area it can be evidenced by stereotypy and repetition. For example, an hysterical patient complained that when she began to comb her hair she could not stop. Another could not pronounce a word without numerous repetitions. Pathological inertness may be highly concentrated in a particular functional area of the cortex, leaving other areas unaffected. Thus in some cases of paranoia and obsession, in which inertness is the mechanism, the person may be able to function wholly normally in all but one particular aspect.

Applying the concept of pathological inertness to the case of the young woman, Pavlov says, "Having attained maturity, the girl experiences a natural sexual attraction towards a man. Individual, ethical and social requirements have not allowed, have detained and are detaining the realization of this attachment. A clashing between the nervous processes takes place. A disturbed state of the nervous activity ensues, finding expression in pathological inertness in those parts of the cortex which are connected with struggling feelings and conceptions. The girl has the insurmountable, obsessive conception that her sexual attachment is reflected in her face in the form of crude sensuality. In the ward she hides her face in the pillow even before the doctor."[15]

The clash of the two forms of nervous activity had led to a

concentration and inertness of excitability, and a weakening of inhibition in the relevant cortical cells, resulting in a fixed idea. The latter is not a "purely psychical" phenomenon, but rather is the result of a disturbed nervous functioning due to overstrain. The cure, therefore, lies not in probing the psychic phenomena, but in the restoration of healthy nervous functioning.

In his further analysis of the case of the young woman, Pavlov accounts for the second phase of her delusion—namely, that the seducer, the serpent, lives in her body—by the deepening of the protective inhibition, the extension of hypnosis or partial sleep in the ultraparadoxical phase. In this phase, the final one before complete inhibition, positive conditioning is transformed into a negative one. Thus he says:

"In the above-described unexpected conclusion of our patient we come across this truly physiological fact. The girl possessed a constant and deeply-rooted idea of her sexual purity and inviolability. She held it a moral and social stain to experience sexual attachment, even if subdued and not in the least realized. This concept—owing to the generalized inhibitory circumstances in which the patient resides and which, in the weak nervous types, usually accompanies a state of difficulty—irresistibly, physiologically, changes into a reversed one (slightly veiled). The latter reaching the intensity of a sensation, causes the patient to feel the presence of the sexual seducer in her very body."

His summation is that "consequently, in the present case, at the basis of the delusional state are to be found two physiological phenomena—pathological inertness and the ultra-paradoxical phase, existing either separately or conjointly, or in succession."[16]

In all the cases analyzed by Pavlov he concentrates on the patho-physiological processes which lie at the base of abnormal mental behavior, the psychical symptoms or syndromes, whether they be hypochondriacal, hysterical, obsessional or delusional. The essential principle is that mental activity (thoughts and emotions) takes place in a physiological, that is, higher nervous basis. Abnormal mental phenomena thus occur on the basis of disturbed higher nervous processes. The indication for therapy

is, then, the restoration of healthy functioning of these nervous activities.

There was nothing mechanical in Pavlov's approach to mental illness. As in all other phases of his work, he viewed the human being as a complex integrated whole which could be understood only in its organic unity and in its relation to its entire conditions of life. Mental illness, he held, was caused for the most part by the conditions of life putting too great a strain on the delicate cells of the cerebral cortex. This strain could be the result of the clash of ideas or emotions as well as such shocking events as war, death of a loved one, or unrequited love. Nor were the effects of overstrain of the nervous system limited to mental phenomena. According to Pavlov, various illnesses of the body were the result of disturbed nervous processes. In turn, these somatic illnesses could act back again on the higher nervous disturbances, heightening them. At the same time, the mental outlook and attitudes of the patient were viewed as vital in affecting both the course of the illness and the possibility of cure. It is a primary task of psychotherapy to build in the patient a positive attitude toward the treatment. Pavlov knew that "emotional influences may often be far stronger than any physical factor, that a spoken word may cause profound changes in the entire organism."[17]

Characteristic of all Pavlov's work was a profound humanism. He was concerned, whether in the laboratory or in the clinic, with the advancement of knowledge for practical human ends, the health, development and well-being of people. At the same time, narrow practicalism was never part of his make-up. He proceeded on the basis that scientific knowledge, experimentally verified, is the most powerful influence leading to practical results and hence to human happiness.

While Pavlov's analyses of specific cases, as above, are illuminating with regard to his approach to mental illness in the psychiatric clinic, they are no substitute for systematic presentation. We proceed now to consider some of the basic theoretical principles advanced in his work on the clinical patho-physiology of the higher nervous activity in man.

Chapter VII

CONTRIBUTIONS TO A SCIENTIFIC PSYCHIATRY

THE BROADEST GENERALIZATION Pavlov made from his work in the psychiatric clinic was an attempt to systematize the disturbances he observed there on the basis of their localization in the different parts and functional systems of the brain.[1] Here already we will see a great qualitative difference between human and animal neuroses, reflecting the tremendous qualitative difference between human and animal higher nervous processes and conditions of life.

Pavlov distinguishes three higher nervous systems in man—one unconditioned and two conditioned reflex systems. Animals have only two such systems, one unconditioned and one conditioned. This already marks a qualitative difference which will find expression in the nature of human pathological disorders. The three systems are: first, the system of unconditioned reflexes, or "instincts," located in the sub-cortical regions; second, the first or sensory signalling system located in the cerebral cortex; and third, the second or speech system of signalling also located in the cortex. Thus man has one sub-cortical and two cortical systems, while animals have one of each. The fact that human beings have three systems, the interrelations of which can become disturbed, indicates the far greater complexity of their pathological states. Following is a summary of Pavlov's views on both the healthy and pathological functioning of the three systems.

All three systems are concerned with establishing a dynamic equilibrium between man and his environment, adapting his behavior to external conditions, or, as is so distinctively human, adapting the environment to his needs.

The system of unconditioned reflexes, seated in the subcortex, embodies those adaptations to the more permanent features

of the environment which have in the course of human evolution, become hereditary. Examples are found in their "pure," unconditioned form primarily in infants immediately after birth, such as sucking any object that touches the lips, grasping anything that comes in contact with the palm of the hand, swallowing almost anything that enters the mouth, and certain pain and pleasure responses, like crying and gurgling. Unconditioned reflexes can be found in their pure state, by and large, only in infancy because, as we saw in the chapter on psychology, they rapidly become covered or interwoven with conditioned reflexes in the course of life. This accounts for the fact that pathological derangements of the unconditioned functions of the sub-cortex often show themselves first in disturbances of conditioned reflex activity in the cortex, particularly of the sensory signalling system, that is, the sensuous emotional and imaginative activity of the individual. For example, a derangement of certain unconditioned reproductive reflexes may first cause emotional disturbances which then show up in disturbed unconditioned sex activity. Disorders of the unconditioned reflex system develop in some cases mainly in the subcortical regions, and in other cases, mainly in the cortex. The latter would be classed as psychogenic disturbances, and the former as somatogenic.

The next higher system is the first or sensory system of signalling reality. It is the first stage of the learning process or the process of cognition, of getting knowledge of the external world. It is learning by the concrete, immediate sense experience acquired in the course of social practice. It is the *perceptual stage* of cognition. The first signalling system is the vehicle of sensuous, imaginative, emotional thought acting under the direct speechless influence of the surrounding world. Its function is to receive, and make initial correlation among sense images reflecting external objects, their actions and properties. It also receives stimuli from the internal environment of the human organism, for example, from the muscles involved in the labor process or from internal organs or entire systems of organs. Pathological disturbance of the first system of signalling may be evoked by excessively powerful or conflicting situations which overstrain the cortical cells involved. Pathological

disturbances of the sensory system may also be the result of disorders in either the higher or the lower system, the speech or unconditioned systems. In the latter case, the disturbance may result from a pathological condition of some internal organ which sends out unusual or excessively strong stimuli to the respective cortical cells of the first signalling system, causing overstrain.

The highest system in the process of human adaptation of environmental conditions is the second or speech system of signalling reality. The function of this system is to make abstractions and generalizations by means of the spoken or silent use of words. It is the *rational stage* of cognition, in which interconnections are made between the relatively isolated sense images of the first signalling system, and their significance evaluated and conclusions drawn. This is what Pavlov spoke of as the "specifically human, higher mentality." The second signalling system also makes possible learning from the experience of other people and previous generations. It makes science possible, and thus furnishes truly effective guidance to concrete practice. Thus, in its healthy waking state, it regulates and coordinates the activity of both the first signalling system and the system of unconditioned reflexes. Pathological disturbance of the second system of signalling may arise through excessively powerful or conflicting verbal stimuli coming from other people or from the individual's own thought in the form of silent speech, in which latter case, the original stimuli will always ultimately come from the external world. It may come from excessive conflict between present verbal stimuli and our ideals and aspirations. Or pathological disturbances may arise as a result of influences proceeding from the two lower systems. To complicate the matter even further, disturbances of the second signalling system may invoke disturbances in the two lower systems and in the body as a whole. Spoken words, such as news of the death of a loved one, may, under certain conditions, produce pathological disturbances in all three systems and in the internal somatic and vegetative environment.

In the Pavlov laboratory, it was found that, while one of the separate systems may be the initial source of the disturbance, the usual tendency is for it to affect the correlations between all

three systems and to spread to all of them in a greater or lesser degree. One way in which this takes place is that when a higher system is under protective inhibition due to overstrain, it thereby ceases to exercise its normal regulative control over the lower system, with the result that the lower system now functions without the influence of the higher, is free to act without the restraining influence of the higher. In this way, a disturbance in a higher system invokes a disturbance in a lower one. An example is the highly volatile and imaginative thought in certain forms of schizophrenia in which the second signalling system is under inhibition, and thus its customary influence on the first system is not exerted.

In the psychiatric clinic, the *symptoms* of mental disorder, such as disturbed behavior and distorted emotion and thought, were considered by Pavlov to be manifestations of general or local disturbances of the three systems of higher nervous activity. The particular form of the disturbance was found to depend, among other factors, on the type of nervous system of the patient. Thus another important generalization from the clinical work concerns the question of type in human beings.

Types of Human Nervous Systems

Pavlov viewed the problems of human types as highly complicated and therefore to be approached with extreme caution. The complexity is a result not solely of the far greater intensity of the nervous processes themselves, but even more of the social character of the human environment. Thus the three properties of the nervous system discovered in work with animals—force, equilibrium and mobility—while holding for the determination of type in human beings, are highly complicated by being formed in a social setting. This can readily be seen by taking one property, the force or strength of the processes of excitation and inhibition. The weakness or degree of strength of a given nervous system in man is subordinated to the social value of the personality. People are taught to develop character traits, perseverance, strength of will, endurance, struggle against great odds, overcoming hardships, loyalty to class, which can compensate to a greater or smaller extent for weakness of the cortical

cells. Strength of the nervous system is an asset in a human being, but the social values, character and personality traits and consciousness of what is expected of one, play the decisive role. To meet the unfavorable external conditions and severe life situations with which we are all faced in our society, strength or weakness of the cortical cells, alone, will not determine whether our nervous systems hold up or break down under the strain. Even more important is the ability to find correct solutions to the problems life poses, to find the right way out of complicated situations. Here knowledge of principles and the ability to apply them to concrete conditions are decisive. The strength, then, of the human nervous system is secondary to the knowledge and character of a given person acquired in the course of life through social practice.

What holds for the strength or force of the nervous system, is true also of the other properties, equilibrium and mobility. Whether the nervous processes of excitation and inhibition are balanced with regard to their strength and whether the nervous system is able to make quick changes to meet new situations, the decisive thing is the previously moulded character, knowledge and practical ability of the person. These, more than the properties of equilibrium and mobility, will determine whether or not there will be overstrain of the nervous system when confronted with the hardest knocks of life.

These discoveries led Pavlov to introduce two new criteria for the determination of nervous type in human beings. In addition to force, equilibrium and mobility, the question of human types must be studied in terms of the peculiarities of the interrelations between cortical and subcortical activity on the one hand, and between the first and second signalling systems on the other. In short, to determine human type, all the influences to which the given individual has been exposed must be taken into account.

On the basis of the predominance of one or the other signalling system, or their balance, Pavlov classifies human nervous systems into three very general types. *In the course of their life experience,* some people develop either a domination of the first signalling system over the second, on one extreme, or a domination of the second over the first, on the other extreme;

or, as is the case with the vast majority, there is developed a balanced interrelationship between the two systems with the speech system playing the role of regulator. To understand this theory of human types, we must investigate further the nature of, and relation between, the two signalling systems. The problem centers around the nature and role of emotions and of thought.

Animals, as we know, are limited to the first system of signalling reality. They receive signals from the environment solely in the form of sense stimuli which act on the sense organs and thence on the higher parts of the brain. Animal emotions, that is, the effects of the given stimulus on the well being of the animal, are made manifest in two ways: by such active phenomena as running, snapping, biting; and by such expressive phenomena as barking, growling, whining, drooling, hair standing on end. The effect of the stimulus on the well being of the animal is made by the nervous paths which have previously been opened in the course of life between conditioned signals and unconditioned reflexes. This means that the emotional tone of sensory signals is furnished by whatever unconditioned responses they call forth, such as those connected with defense, feeding and reproduction, on the basis of conditioned connections. Thus animal emotions are an important aspect of the relationship between the sensory system located in the cortex and the system of unconditioned reflexes located primarily in the subcortex. It could be said that animal emotions, together with their expression in activity and bodily changes, comprise the essential feature of the interrelationship between the cortical and subcortical processes, or in other words, between the first signalling system and the inborn reflexes. *Animal activity, in this sense then, is always emotional activity.* The animal reacts to a stimulus on the basis of what immediate effect it promises for the animal; and it does this solely by means of previously formed conditioned reflexes. For example, a dog may react to the sounds customarily accompanying the preparation of its food by excitedly running to and fro, barking in a high pitch, wagging its tail and drooling. "Animal emotions" are the animal's responses determined by the conditioned connections between the cortical and subcortical processes.

There is, however, very little gained by using the term "emotions" with regard to animals. This is true because there is no other phenomenon to which emotions are opposed. Emotions in animals are concerned with the direct effect of an external (or internal) stimulus on the immediate vital activity of the animal. Since animals react solely in terms of such effects, there is little point in calling it "emotional" activity; *activity* alone is sufficient. The only reason for raising the question here is as an aid in approaching the question of emotions in human beings.

With people, emotion takes on meaning since there is a phenomenon in opposition to it, namely, idea or verbal abstraction. Emotions and ideas are different aspects of consciousness, of the reflection of objective reality in the human mind. The primary role of *ideas* is to reflect objects and processes as they exist in the external world. Ideas, to be true, must be verbal signals which correspond to the objects of which they are the reflections, regardless of the subjective feelings of the person. The primary role of *emotions,* on the other hand, is the evaluation of the significance for the individual of the objects reflected in ideas. Every idea, therefore, has more or less of an emotional tone. There is no emotion without idea, and conversely, no idea without emotion. It is the emotional aspect of the reflection which mobilizes a person and puts him into action. The more true understanding a person has, in the form of ideas, the more appropriate will be his emotional response. For example, the appropriateness of the emotional reaction of a tenant upon receiving an eviction notice will depend primarily on the degree of ideational understanding he has concerning the possibilities of a struggle against eviction, such as the legal measures available or the resources of the tenants council. The more limited his knowledge of these things, the less appropriate and the more panicky will be his emotional response; and the more he knows, the more appropriate and stable his reactions. Thus in human beings, ideas and emotions are two indispensable and inseparable aspects of the reflection of reality in consciousness.

The higher nervous activity underlying emotions and ideas and their interrelationship involves the three systems; the sen-

sory and speech systems of the cortex and the system of unconditioned reflexes of the subcortex. Since ideas are always verbal abstractions, the second or speech system of signalling comprises their underlying nervous activity. Emotions, on the other hand, are primarily the interrelated work of the first or sensory signalling system and the subcortical unconditioned system. This brings us back to the question of type of nervous system in human beings.

In the vast majority of people there is a close relation between the nervous processes underlying ideas and emotions. Ideas or verbal abstractions arise out of the direct sensory signals of reality, in the course of social practice, and are tested back again in the sense experience of practical activity. Emotions, in this middle type, while being the work of the first signalling system and the unconditioned reflex system are under the controlling regulation of the second or speech system, that is, they are regulated by a given fund of more or less true ideas. Thus, in the middle type comprising the great majority of people, a balance exists between emotional and ideational activity expressing a balance of the underlying higher nervous systems, both in turn formed by experience and social practice. In terms of the three essential properties of nervous activity, the middle type would be strong, equilibrated and mobile in varying degrees. It must always be kept in mind that the type is formed in the course of life, in meeting obstacles and overcoming them, in absorbing hard knocks, in continuous struggles; and the type has a high degree of plasticity, that is, it can change in relation to changing practice.

In addition to the middle type, there is, at one extreme, the type in whom abstract ideas are partially divorced from concrete imagery and emotions, and from practice. Here is the "dogmatist," "disembodied intellect," who tends to live in a realm of verbal abstractions and to mistake it for reality. This is not, it must be stressed, a pathological condition, but is a rather common imbalance in a society which tends sharply to divide the work of head and hand. In terms of underlying higher nervous activity, this "intellectual" type represents the predominance of the second signalling system over the first together with a certain amount of dissociation between them. Abstract

verbal signals do not, in this type, customarily arise immediately out of concrete sense experience in the course of practice, nor are they always checked back again in sensory practice to determine their truth or falsity. This extreme is the cloistered academic type living in a rarified realm of abstraction.

At the other extreme, beyond the balanced middle group, there is the type in whom imagination and emotion are partially divorced from the regulating influence of ideas or verbal abstractions. Here is the "bohemian" who tends to live in a world of sensory images and emotional reactions, mistaking it for reality. Again, this extreme is not a pathological condition, but, as in the case of "pure intellectuals," is a rather common imbalance produced by a society which divorces emotions from ideas and maintains that the "artist" must feel and not think, in the same way that the "intellectual" must think and not feel. In terms of underlying higher nervous activity, the emotional type represents the predominance of the first signalling system and perhaps the subcortical processes over the second signalling system with more or less dissociation between them. Concrete sensory signals are not, in this type, under sufficient regulation of ideas or abstract verbal signals, with the result that immediate sense experience and emotional reactions, rather than scientific knowledge, tend to form the basis of their thought and activity. The emotional type tends to react to immediate sense stimuli in terms of highly colored feelings without much intervention of rational thought. Thus he is often flighty, with moods ranging in succession from elation to despair, depending on the fluctuations of the immediate sense images.

Pavlov called these two extreme types respectively the "thinker" type and the "artist" type. Pavlov was a teacher as well as a scientist, and he sometimes used terms which would dramatize his meaning but which required careful qualification. Such is the case with the terms "thinker" and "artist" when applied to types of human higher nervous activity. He wanted to indicate in a forceful manner that the extreme types are based on the predominance of one or the other of the two signalling systems. Since artists are popularly supposed to be purely emotional and thinkers purely intellectual, he used these terms to put across his point. As has been indicated, in capitalist so-

ciety there are powerful forces at work to produce both the misconception of artists and thinkers, and actually to develop occasional individual artists and thinkers who fit the type. It is clear, however, that by no means all artists or thinkers are representatives of the extreme types. Genuine artists and scientists would belong, for the most part, in the majority middle group of balanced higher nervous activity in which ideas and emotions, the second and first signalling systems, are in close interrelationship but under the regulation of the highest system, the peculiarly human system of speech signals. On the other hand, any person, whether or not he be artist or thinker with regard to his profession, can, as a result of his life experiences, be representative of one or another extreme or unbalanced type of nervous system.

General Neuroses

Pavlov studied the question of type of higher nervous activity in man because of its relation to the most general forms of the specifically human neuroses. In his own words, he found, "Constitutional neurasthenia is a form of general weakness, occurring in the middle human type, hysteria is the result of general weakness in the artistic type; psychasthenia is a product of weakness in the thinking type."[2]

Neurasthenic states develop most commonly in the middle human type as a result of acute or prolonged overstrain of the nervous processes. Most frequently they are brought about by such influences as psychical and physical exhaustion, and highly charged mental or emotional situations or conflicts. People suffering from neurasthenia may be strong individuals who are still able to carry on a large amount of activity and may accomplish much in life. Pavlov remarks that many prominent people have been neurasthenics. But they have periods of weakness and temporary fatigue, due largely to the fact that they are continuously excited and active. The resulting exhaustion may take its pathological toll in one or more of three stages of neurasthenia. The first stage is characterized by a weakening of the inhibitory processes, particularly inhibitions elaborated in the course of the individual's life, of those emotional reactions which

are not in conformity with social demands, for example, lack of restraint, irritability, anger. There is a decline in self-control, discipline, self-possession and reserve. Thus in the first stage of neurasthenia the processes of inhibition suffer from weakness due to overstrain and exhaustion.

In the second stage the excitatory processes begin to weaken; they react quickly but lapse just as rapidly into exhaustion. The result is a general tiredness. Here the underlying nervous disorder is called pathological lability of the excitatory processes, that is, they are easily evoked but quickly die down.

In the third stage of neurasthenia, overstrain and exhaustion have led to irradiating transmarginal inhibition the function of which is to protect the cortical cells from further work so that they may rest and so that the restorative metabolic process can set in. This is the stage of general neurasthenia characterized by heightened inhibitability and drastically lowered reactivity.

Depending on a number of factors, including the nature and degree of overstrain and exhaustion, one of these three stages may be protracted and the others held either in abeyance or not appear at all. On the other hand, neurasthenia, under certain conditions, may run its full three-stage course. It is possible that the first stage, for example, might endure a lifetime, if not treated and not aggravated by excessively severe conditions. Or the third stage may be reached almost at once if the overstrain or exhaustion is extreme. In most cases of neurasthenia, in whatever stage, there are sharp disturbances of the vegetative processes such as digestion. This is usually caused by the weakening of the cortical regulation of the subcortical vegetative centers.

Psychasthenia* and hysteria, characteristic respectively of the so-called thinking and artistic types, were considered by Pavlov to be the most specifically human of the general neuroses because they involved derangements of the dynamic correlations between the first and second signalling systems. He viewed psychasthenia

* At the time Pavlov was investigating neuroses in human beings the diagnoses of functional mental illnesses were those originally classified and named by the famous german psychiatrist, Kraepelin. Freud also used this diagnostic classification. Neurasthenia, hysteria and psychasthenia, were terms employed to indicate general neuroses. Of these, "hysteria" and "neurasthenia" are still in use, but "psychasthenia" is obsolete.

as a pathological extreme of the thinking type, and hysteria as a pathological extreme of the artist type.

The psychasthenic state is characterized by strongly pronounced and heightened rationality, by an abundance of socially unnecessary inhibitions acquired in the course of life, and by exceedingly feeble emotions and inclinations. The psychasthenic is often beset by painful doubts when he has to act in new and unusual situations, and has a peculiar capacity for substituting endless reasoning for quick and resolute action and for expressing his emotions. According to Pavlov, the pathological disturbance of the higher nervous processes underlying psychasthenia consists in the morbid predominance of the second signalling system over the first and of cortical over subcortical processes. Abstract words, thoughts, reasoning are, in the psychasthenic, far stronger than the more direct signals of reality, the sensory signals arising in practice and the emotions they arouse. Therefore there is a weakened sense of objective reality in which words, ideas, rationalizations seem more real than sense experience and action. Accompanying this lack of a sense of material reality, the psychasthenic has a continuous feeling that concrete life is inferior to his conceptions and idealizations of it. Thus he tends to withdraw still further from reality, to shut himself away in an ideal world of his own making. But the real world, continually intruding on his privacy, threatens his idealizations, and he may develop obsessions which are forms of local neuroses.

We proceed now to the final form of general neuroses, hysteria, most characteristic of the so-called artist type of human nervous system.

The neurotic state of hysteria is characterized by highly emotional and imaginative thinking, by a tendency to substitute fantasy for a rational approach to reality, and by rash and impulsive actions. The pathological disturbances of the higher nervous processes underlying the clinical symptoms of hysteria are a morbid predominance of the first signalling system over the second, and of subcortical activity over cortical. In the artistic type, general weakness due to overstrain leads naturally to a greatly exaggerated predominance of the sensory over the speech system, of emotional over rational thought. The normal regulating influence of the second signalling system all but disappears with

the result that the activity of the first signalling system becomes chaotic and is characterized by pathological fantasies and unrestrained emotional behavior. The constant predominance of emotional excitation in hysterics can lead to a degree of overstrain of the cortical and subcortical cells which brings on irradiating transmarginal inhibition the function of which is to protect these cells from organic damage. The irradiating protective inhibition may pass through the various hypnotic phases between wakefulness and sleep such as equalization, paradoxical and ultraparadoxical phases with their particular clinical syndromes of suggestibility, catalepsy, twilight states, anasthesia, and paralysis. Thus hysterics are particularly susceptible to the inhibitory states of partial sleep or hypnosis. These are forms of localized neuroses which may develop as the general hysterical neurosis becomes more severe. They are to hysteria in the artist type what obsessions are to psychasthenia in the thinking type, that is, new developments in the form of local disorders which are in themselves separate forms of mental illness.

With regard to all three forms of general neuroses—neurasthenia, psychasthenia and hysteria—and their relation to the type of human nervous system, a qualification is in order. Any one of the three general neuroses can occur under appropriate conditions in any one of the three types. The question of type, therefore, does not mean *exclusive* susceptibility to one form of neurosis. Rather, it indicates *heightened* susceptibility. For example, while the artist type is most susceptible to hysteria, a representative of this type can, under certain circumstances, be afflicted with either neurasthenia or psychasthenia.

What we have been dealing with here is the patho-physiological basis of general neuroses, the various morbid disturbances of the higher nervous activity which underly the syndromes of neurasthenia, psychasthenia and hysteria. The three forms of general neuroses are nervous breakdowns caused by life situations resulting in overstrain of the cortical processes. The overstrain produces dislocations between the cortical signalling systems, and between the cortical and subcortical activity. They are peculiarly human forms of neuroses since they all involve in one way or another the special human speech system of signalling. They are functional, not organic, forms of mental illness and sooner or later in

many cases recovery sets in of its own accord if not by medical intervention. This fact, by the way, could account in part for those cases where pseudoscientific therapies, for example, psychoanalysis, appear to have produced cures, where the analysis takes years of twice-weekly office visits to "work.' After recovery, however, there persists for a long time a pathological point or dynamic structure as a trace of the original neurosis. Any living situation which touches at this point, even remotely, may be sufficient to revive the structure and symptoms of the neurosis for a brief period at least. The trace persisting after recovery is therefore a constant source of possible recurrence of the breakdown.

To eliminate the complex of symptoms, the syndrome, of one or another of the general neuroses, that is, to cure the mental illness, the essential requirement is to restore the healthy functioning of the underlying higher nervous activity, the interrelations between the cortical signalling systems and the cortical and subcortical processes. Pavlov's clinic found that bromides, combinations of bromide and caffeine, and sleep therapy were the most effective known forms of treatment of neuroses. In all cases, however, the effectiveness of the therapeutic measures depended primarily on their precise and individually adapted prescription. By identifying the patho-physiology of various neuroses, Pavlov was able in some cases to prescribe scientific methods of treatment. Without a science of the higher nervous activity underlying mental illness, there can be according to Pavlov no genuinely scientific therapy and without the patho-physiology of the brain, there can be no truly scientific psychiatry.

We cannot enter into a systematic discussion of Pavlov's work on the various forms of local neuroses or of his study of psychotic states. Suffice it to indicate, as the cases cited in the first part of this chapter show, that he approached the more severe types of mental illness in the same way he dealt with general neuroses: he sought to discover the patho-physiological states underlying and giving rise to the clinical syndromes. He found that in general these pathological mechanisms involved dissociations of the dynamic correlations between the two signalling systems and between the cortical and subcortical processes; and that in particular the mechanisms involved such disorders

as pathological inertness of ideas and emotions, hypnotic phasic states, and so-called isolated pathological points or dynamic structures. He was convinced that the essential cause of neuroses and psychoses lies in the shocks and conflicts to which the human nervous systems are subjected in the course of living. This cause is, of course, operative above all in capitalist society, especially in its late stages. Little wonder that mental illness is most devastating precisely in the United States today.

During the closing years of his life Pavlov made significant progress in the development of measures for the treatment of functional mental illness. Of special importance were his theory and practice of sleep therapy, his conception of the basis for a scientific psychotherapy, and his recommendations for the reorganization of the psychiatric hospital.

Pavlov's Work on Scientific Therapy

Pavlov was by no means the first to use sleep therapy. Prolonged narcosis in the treatment of mental illness, particularly schizophrenia, was already being employed around the turn of the century and had become widespread by the late twenties. But the toxic effect of the narcotic drugs was a serious problem, leading to considerable death rates. Then in 1934 two Swiss scientists, M.u. Cloetta and H. W. Maier, published a report on the use of a narcotic mixture, which, according to them, drastically reduced the toxic effects of prolonged narcosis. Pavlov began his work on sleep therapy with the aid of Cloetta's mixture.

In point of fact, prolonged narcosis is not strictly a form of sleep therapy, for narcosis is a stuporous and anasthetic condition produced by a narcotic agent. Prior to Pavlov, it was used almost exclusively in forms of mental illness where there was a pathological condition of the excitatory processes. Pavlov, however, used Cloetta's mixture only in those cases in which protective inhibition was an important component of the illness. Thus he used the narcotic agent to intensify and deepen the natural protective measures already operating within the patient's brain. He employed it, that is, to promote and strengthen the defensive nervous mechanism which nature itself had provided and developed in the form of transmarginal or protective inhibi-

tion. His theory of prolonged narcosis was, therefore, precisely the opposite of his predecessors; they used it to quiet excessive excitation; he used it to reinforce irradiating inhibition.

This change was highly important for it allowed the narcotic drug to be used in relatively small doses as a reinforcement of the natural tendency to sleep. In this way a state approximating ordinary sleep was substituted for the wholly artificial stuporous state of narcosis. Pavlov was able to make the change because of his science of higher nervous activity in which the natural mechanism of protective inhibition played an important role. Here is a good example of the difference between therapeutic measures firmly rooted in scientific principles and those based primarily on the improvisation of practical medicine. Pavlov developed his theory and practice of sleep therapy as a unity of the age-old practical knowledge of physicians that maximum rest is one of the most effective therapeutic measures in medical treatment of illness, whether of body or of mind, and his own experimentally demonstrated theory of protective inhibition. It was a marriage of tested practice and proven theory.

In the psychiatric clinic attached to Pavlov's laboratory, narcotic sleep soon took the place of prolonged narcosis. A special room, large enough to accommodate twelve to fourteen patients, was set aside for sleep therapy. The windows were heavily draped to shut off daylight and the floors were carpeted to deaden sounds. Attendants were trained to carry out their duties as silently as possible. As an aid to sleep Pavlov employed the inhibitory effect of monotonous and prolonged rhythmic stimuli in the shape of a slowly blinking blue light and the endless beat of a metronome. These stimuli have a similar effect on patients as has a dry, droning lecturer on his audience. The sleep room was attended by specially trained physicians and psychiatric nurses and therapists, and was under the immediate direction of Petrova.

Thus the sleep room was designed above all to furnish the primary conditions for sleep, namely the elimination of external excitatory stimuli. In his laboratory, Pavlov had found that the sound-proof, light-proof and odor-proof experimental chambers almost automatically produced sleep in dogs that were waiting for an experiment to get under way. The theoretical principle underlying this phenomenon is that inhibition will continue to

irradiate unless and until it is met, checked and reversed by an excitatory process. The sleep room was designed to eliminate as far as humanly possible all external excitatory stimuli which might checkmate the spread of protective inhibition over the patient's cortex and down into the lower parts of the brain.

In human beings, however, as we all know only too well, the very absence of external stimuli, the darkness and silence of two o'clock in the morning, can itself become oppressive if our internal thoughts, worries and fears are sufficiently excitatory to turn back the irradiating inhibition which alone can produce sleep. To meet this type of situation, which of course in mental patients can be highly exaggerated, Pavlov kept a psychotherapist on duty. The primary function of the therapist in the sleep room was to calm the wakeful patient by acting directly on his second signalling system by means of the spoken word, the special feature of psycho-therapy. The talk was directed toward taking the mind of the patient away from himself, allaying his fears, calming his excited state, so that lack of external stimuli and the monotonous agents could do their work with the aid of a relatively mild narcotic mixture.

A number of patients, up to the capacity of the room, were simultaneously treated by sleep therapy for a period ranging from six to twelve days. The period was usually interrupted in the middle for ten to twenty hours during which the narcotic mixture was not given but the patients continued to sleep under their own steam, as it were. The purpose of this was to minimize the toxic effect of the narcotic drug.

Sleep therapy was used by Pavlov principally in the treatment of those forms of schizophrenia where protective inhibition played a role in the nervous mechanism of the disease: in catatonic and depressive stuporous states and in hypnotic phasic states intermediate between wakefulness and sleep. In a newspaper interview appearing before his death, Pavlov said that he was "astonished at the favorable results" obtained by his clinic in the field of narcotic sleep therapy and that he regarded this as "an encouraging and promising start in bringing together experimental physiology and pathology of the higher nervous activity and the clinic of nervous and mental diseases."

As indicated above, psychotherapy, treatment by making mental suggestions or impressions through the spoken word, was

used in the Pavlov clinic in conjunction with psychiatric therapy. Its employment in connection with sleep therapy, as we saw, was to reduce excitation and thus make way for irradiating protective inhibition. It was found, however, to have other effective uses. For example, in certain cases, psychotherapy was employed in the second stage of therapeutic treatment, following sleep therapy. In such cases it was used to stimulate the excitatory processes to help bring them back into balance. Psychotherapy was also used to develop positive attitudes in the patient toward his illness and toward the therapy he was to undergo. The theory underlying Pavlov's use of psychotherapy is based on the regulative role of the second signalling system in human beings. Acting directly on this system by means of spoken words can bring important influences to bear on the functioning of all three higher nervous systems and their correlations, and in addition on the vegetative and somatic processes of the body as a whole. There is nothing in the least mystical about this, since the speech system itself is a material nervous process like the others. Any attempt to deny the physiological effect of speech is to take a dualistic approach to mind and body, for it is equivalent to maintaining that mental activity is not higher nervous activity, that it is "purely mental."

In addition to the innovation of the sleep therapy room, Pavlov made a number of recommendations for the reorganization of the psychiatric hospital, and carried many of them out in his own clinic. In general he maintained that a hospital for the mentally ill should be more like a sanatorium, since in his view the primary function of such an institution is to afford as complete rest as possible for the patient so that the restorative processes can do their work. Among his more specific recommendations was the proposal to separate those patients who still retained some degree of self-consciousness from those who were totally unresponsible for their behavior. In arguing for this innovation Pavlov reveals his profound humanism and his concern for individual rights:

"Though enormous progress has been made since olden times up to our day in the treatment of the mentally ill, still, I think, something remains *to be desired* in this respect. To keep patients still possessing a certain degree of self-consciousness, together wtih

other, irresponsible patients, who may subject them, on the one hand, to strong stimulations in the form of screams and extraordinary scenes, and, on the other, to direct violence, in most cases means creating conditions which to a still greater extent enfeeble the already weak cortical cells. Moreover, the violation of the patient's human rights, of which he is already conscious and which partly consists in restriction of his freedom, and partly in the fact that the attendants and medical personnel naturally and almost inevitably regard him as an irresponsible person, cannot but strike further heavy blows at the weak cortical cells. Consequently, it is necessary as quickly and as timely as possible to place such mentally diseased in the position of patients suffering from other illnesses which do not offend human dignity so manifestly."[4]

Thus having established that neuroses and psychoses are not only deviations in thought and behavior, manifested in certain syndromes, but that, underlying the symptoms they are more essentially "chronic deviations of the higher nervous activity, lasting weeks, months and even years,"[5] Pavlov made an important initial step toward a scientific psychiatric therapy. This work was carried forward after his death by his students and collaborators, particularly by M. K. Petrova, K. M. Bykov, E. A. Asratyan, M. A. Usiyevich, A. O. Dolin and A. G. Ivanov-Smolensky.

Some Recent Developments in Soviet Psychiatry

Pavlov's science of higher nervous activity did not triumph in the Soviet Union without a struggle, as was clearly demonstrated at the *Scientific Sessions on the Physiological Teachings of Academician I. P. Pavlov,* held in 1950. It was particularly difficult for the psychiatrists to accept and master the Pavlovian approach to mental illness. Thus Ivanov-Smolensky in his "Reply to the Discussion," remarked: "How hard our psychiatrists find it to assimilate Pavlov's teachings!"[6] It is perhaps, especially difficult for those in the fields of psychology and psychiatry to embrace the Pavlovian approach, for here the idealist, reactionary ideology is most deeply entrenched.

Since 1950, however, considerable progress has been made in

Soviet psychiatry. V. E. Galenko of the Central Institute of Psychiatry of the Ministry of Health of the U.S.S.R. reported in January of 1953 that treatment of various types of mental illness by sleep therapy had increased from 28 hospitals in 1949 to 46 hospitals treating 3,400 patients in 1950. The form of protective inhibition most in use was interrupted narcotic sleep with the aid of various drugs, including barbiturates combined with caffein. Among the illnesses treated by sleep therapy were schizophrenia, manic depressive psychoses, psychoses and reactionary states, obsessional neuroses and pathological development of personality. It was found that sleep therapy is especially effective in the treatment of schizophrenia when it is in one or the other stages of partial protective inhibition, the phases between sleeping and waking, the paradoxical and ultra-paradoxical phases. Thus it is most effective in the treatment of patients suffering from catatonia, depressive catatonia, hallucinations and depressive hypochondria. It is interesting to note that each treatment usually lasts from five to fifteen days.[7]

Dr. Galenko warns that sleep therapy is not to be considered a panacea for all mental afflictions. It has been proven effective in many types of illness, but careful study is required to apply it where it is clinically applicable. This is particularly true, because, as Pavlov pointed out, it is necessary to distinguish between two types of phenomena, both of which may exist in one patient: one, the action of infectious agents and, two, the auto-defensive reactions of the organism for protection of the nervous system, that is, protective inhibition. The latter are the phenomena particularly amenable to treatment by sleep therapy since this involves heightening of the inhibition which naturally develops where there is overstrain of the nervous processes.

To counteract infectious agents affecting the higher nervous activity, not sleep but convulsive therapy, has been found most effective. This type of treatment rallies the forces of the body in combatting infection. It works on the metabolism of the patient. The types of convulsive therapy found most effective are by sulfosine and cardiazol. Here it should be noted that in the Soviet Union electric shock treatment as it is used in our country is no longer recommended. Convulsive therapy is employed.[8]

Another recent development in psychiatric practice was reported by A. M. Loukina of the psychiatric clinic of the Pavlov

Institute of Medicine in Leningrad. Prolonged sleep by narcotics was found to have a certain harmful effect on metabolism and vegetative functions generally. To eliminate this, considerable work has been done on conditional reflex sleep. The patient is given a narcotic at definite times for three days or so and thereafter given a neutral pill containing no drugs at all. The patient then sleeps due to conditioning to sleep after taking a pill. It was found that in most cases this conditioned sleep was even more profound and lasted longer than narcotic sleep, and, of course, without deleterious effects since drugs were used only briefly in the conditioning process.

Of special interest is the role assigned to explanatory or rational psychotherapy in recent Soviet literature on the subject of neuroses. Thus S. N. Davidenkov, in an article on "The Treatment of Neurotics by Pavlovian Methods," says that "explanatory or rational psychotherapy is naturally fundamental to the treatment of all neuroses." The reason given is that the patient must correctly understand the essence of his ailment. Such understanding, Davidenkov reports, is not very difficult to achieve if the patient is made to realize that the different functions of the nervous system are subject not only to disruption but also to training, and if he is led toward an understanding of how he must set to work to re-train himself.

But above all the patient must become thoroughly accustomed to the idea that his illness is an understandable and curable phenomenon completely subject to given laws. By popular explanation of the Pavlovian teachings, the patient must be made to realize that neuroses consist in a disturbance of the processes of excitation and inhibition in the cerebral cortex. "It is not difficult," Davidenkov says, "to explain to the patient that this state is a natural reaction to the excessive strain on the nervous system that has taken place, and that it is fully reversible. He gives an example of a patient who is worried by sensations with regard to his heart, stomach or other internal organs which cause him to imagine some serious disease. Such a patient is usually calmed by an explanation attributing these pathological sensations to the paradoxical phase of partial inhibition in which small stimuli are received with unusual strength; thus the heartbeat may become a loud drum-beat. Understanding this does not of itself lead to a cure. But it can calm the patient and better

prepare him for the therapeutic task of correcting the malfunctioning of the cortex underlying the symptoms. In this way psychotherapy is "naturally fundamental to the treatment of all neuroses." Davidenkov concludes that "skilful popular teaching of the Pavlovian pathophysiology of the higher nervous activity is a powerful factor in the rational psychotherapy of neuroses," and he adds, "This widespread popular teaching of the Pavlovian explanation of neuroses must also indubitably play a positive part in the prevention of possible breakdowns in people suffering for one reason or another from nervous overstrain."[9]

Soviet psychiatrists, like others, not only have to diagnose the particular form of mental illness and carry out relevant therapy. In many cases, they have to make a prior decision: is the person before me ill? A psychiatrist, Lydia Bogdanovich, writing in the magazine Zvezda, says that cases in her practice frequently turn out to be more social than medical. She goes on to quote from a speech by G. M. Malenkov at the 19th Congress of the Communist Party of the Soviet Union: "Remnants of bourgeois ideology, survivals of private-property mentality and morality, are still with us. These can grow, and a vigorous struggle must be waged against them." Dr. Bogdanovich holds that this task belongs not only to professional writers but to psychiatrists as well, for who but they come into closest contact with the secrets of the heart.

In the course of her article, she reports a number of cases, all of which indicate that the first task of a psychiatrist is to determine whether the "patient" is in fact a *patient,* whether he is suffering from a nervous disorder, or, on the other hand, is a victim of "private-property mentality and morality." In the one case, psychiatric treatment is required. In the other, re-education at the hands of agencies equipped for such work is in order, not the treatment of the higher nervous processes by psychiatrists.

Among other cases, there is one Dr. Bogdanovich calls *The Spoiled Child:*

"A self-important mother brought her 17-year-old to me as a patient and proclaimed, through her tears: 'Irochka is very nervous. She threw a cup at me not long ago. She has been expelled from the Young Communist League. I don't understand her behavior. She has everything. What is lacking?

"I took the case of 'nervous' Irochka. It developed that she had been brought up with everything at her beck and call. Her father, a prominent professor, rarely sees her, but compensates for his paternal neglect by bringing her gifts and giving her pocket money. From childhood she had never been denied anything; she had always been allowed to follow her whims and inclinations without interference.

"Ira showed premature interest in cosmetics. As her mother expressed it, she had 'natural good taste' in dress. But the mother overlooked one important thing; her daughter completely lacked a 'taste' for work. Irochka constantly needed starched dresses and ironed ribbons, but she did not want to launder her things herself. And it didn't even occur to her parents to give their daughter something to do for herself. Everything was done by mommy's hands, 'so Irochka wouldn't be upset.'

"As was to be expected, in school the girl was faced with the necessity of controlling herself and respecting other's opinions. Naturally, the badly brought up Irochka developed conflicts with her teachers and fellow students.

"The demanding school regime began to oppress her. She began to get failing grades. Mother blamed the school and the teachers: 'They don't teach very well.'

"Ira was attracted to friends outside the school, the sort who were allowed to come home late by their parents. Through her new friends she met boys. Once she was not allowed to go to a party. She had a tantrum and threw a cup at her mother. She frequently wept and had hysterics.

"Having told me all this, the mother left the office. I remained alone with the patient. . . . Despite every effort, I could discover no nervous disorder in her. . . .

"I told the mother my diagnosis. She was dissatisfied. According to her theory, the doctor should have coddled Ira, prescribed bromides, baths or other treatment to correct the results of parental helplessness. She did not understand that no medical treatment can replace parents' upbringing."

It was not a case of nerves for medical treatment, but a case of bad education. The only answer to Irochka, according to Dr. Bogdanovich, is "for life itself to re-educate her." "Everything," the doctor concludes, "depends on her future environment."

After reporting a number of similar cases, Dr. Bogdanovich

remarks, "How often such people go to doctors and complain of 'nerves'. Unfortunately, doctors too often write out prescriptions for them, specify baths and inject stimulants. And the person, instead of critically evaluating himself and his acts, continues to blame everything on 'nerves'!"[10]

This illustrates the fact that Soviet medicine draws a rather sharp line between ideological, social and political errors and confusions on the one hand, and mental illness on the other. Re-education, including environmental change in which type of work plays a major role, is the primary answer to the first. Psychiatric treatment in the light of Pavlovian science of higher nervous activity is the answer to the second. To determine whether a person's difficulty is social or medical is not left exclusively to office interviews but may well entail careful clinical examination to discover whether or not there is a nervous disorder.

In the Soviet Union, re-education is not the task of the psychiatrist, although he may contribute. Mental hygiene agencies, whose task it is to maintain mental health and prevent mental illness, are one source of re-education. For ideological, social, personal and political confusion and contradiction can contribute to the development of nervous disorders, neuroses and psychoses. Other agencies would include the trade unions, the sports clubs, the rest homes, the schools, the home and the Communist Party.

This is quite different from the theory and practice of psychotherapy, psychoanalysis and of much that passes for psychiatry elsewhere and especially in the United States. Here there is a marked tendency for social confusions to be lumped together with mental illness, and to be called "neurotic" behavior. To call contradictions in the human mind, reflecting the sharpest contradictions of capitalist society, "neuroses" is a very effective means of substituting "medical treatment" for clear thinking and re-education—for blaming it on "nerves" rather than on society.

From the standpoint of ideological struggle against reactionary theories and practices, which is perhaps the most important aspect in our country, a great value of Pavlov's teachings on psychiatry is that it gives a basis for a more precise definition of mental illness. Such a definition is essential if we are to combat the tendency to turn all mental conflict into symptoms of "the neurotic personality of our times."

The basis for such a definition is Pavlov's insistence that

mental activity must always be regarded as higher nervous activity, while not in any way denying the existence of mental experience. However contradictory, confused or false this mental activity may be, it is not a form of mental illness as long as there is no chronic pathological disorder of the higher nervous processes. Functional mental illness, neurotic or psychotic, is, according to Pavlov, a chronic disturbance of the higher nervous processes lasting for weeks, months or years and requiring medical treatment. This in no sense builds an impenetrable wall between mental activity and mental illness. The former, in heightened confusion and contradiction, can and does, under certain conditions, lead to the latter. But, it is held, as long as there is no pathological disturbance of higher nervous activity, the problem is essentially social, not medical.

According to the *Scientific Sessions on the Physiological Teachings of I. P. Pavlov,* attended, among others, by psychiatrists from all parts of the Soviet Union, the future of the medical science of psychiatry lies along the lines laid out by Pavlov and his fellow workers. This does not mean that all problems have thereby been solved. It does mean, however, that Pavlov's teachings on higher nervous activity are to form a basis of Soviet psychiatry.

As Pavlov himself said, there is a mountain of ignorance to be hewn away. A bare beginning has been made.

Chapter VIII

PSYCHOLOGY AND PSYCHIATRY IN THE UNITED STATES

IN SPITE OF THE overwhelming predominance of subjective idealist psychology in the United States for the past half-century, an objective materialist approach to the human mind is by no means strange to our shores. It has in fact a long history, dating back to revolutionary times. The first American seriously to treat mental life as a function of the brain and as a reflection of external reality was a signer of the Declaration of Independence, Dr. Benjamin Rush.

Benjamin Rush was born on December 24, 1745 at Byberry, Pennsylvania. After graduating from school and college in colonial America, he went to the University of Edinburgh where he received his Doctor of Medicine degree in 1768.

In 1769 at the age of twenty-three, Dr. Rush returned to Philadelphia and began the practice of medicine. His career was given a good start when, in the same year, he was elected Professor of Chemistry at the College of Philadelphia, later to be the University of Pennsylvania. He was the first professor of chemistry in America, and in 1770 wrote the first American textual contribution in the field, *A Syllabus of A Course of Lectures On Chemistry.*

During the years 1774 and 1775 Rush was busy in his spare time gathering arguments for the independence of the colonies from Britain. Sentiment in Philadelphia was still largely Tory, so he wanted to raise the issue of independence in a way that could not be ignored. But about this time he met the woman he knew he wanted for his wife and with the prospect of marriage and family he could not bring himself to ruin his professional career. Thus when in February 1775 he met Thomas Paine who had but recently come to America, he proposed

that Paine write the pamphlet. Paine did so and Rush furnished the title *Common Sense* and arranged for its publication. This was the spark that galvanized the will of the colonists.

During the period of the Continental Congresses, Rush was a delegate from Pennsylvania, signed the Declaration of Independence, served on a number of Revolutionary committees, was a close associate of Patrick Henry and Samuel Adams, Washington and Jefferson. He served in the Army as a medical officer and was instrumental in the procurement of supplies.

By 1790, Rush's work in the service of the Revolution was completed, and he settled down once more to the pursuit of his profession. In 1792 he was elected Professor of the Institutes of Medicine and Clinical Medicine in the new Pennsylvania University. For twenty-five years he taught and practiced medicine, and during that time was clearly the most distinguished physician in the United States. He was a senior physician of the Pennsylvania Hospital and, himself, founded the College of Physicians in Philadelphia, then capital of the new country.

In the course of his work at Pennsylvania Hospital, Rush became concerned with the plight of the "lunatics" housed there. The fifty insane patients were kept chained in dark, damp cells and received little or no treatment. He appealed to the Board of Directors and when that failed took his case to the people through the newspapers. This brought results, for in 1792 the State Legislature appropriated $15,000 for the construction of an insane ward. A wing of the hospital with light, airy rooms and baths was built. He introduced occupational therapy. From that time until his death Rush was deeply concerned with the pathology and cure of the insane. The results of this work in theory and practice formed the subject matter of his final book, *Medical Inquiries and Observations Upon the Diseases of the Mind,* published in Philadelphia in 1812. It was one of the first important medical works on the subject to appear anywhere in the world.

Benjamin Rush prefaced his book with the hope that it would form the basis on which "a system of principles may be formed that shall lead to general success in the treatment of the diseases of the mind," and adds that, "the author believes

these diseases can be brought under the dominion of medicine, only by just theories of their seats and proximate cause." It was his hope "that this work may be the means of lessening a portion of some of the greatest evils of human life."

Rush set forth two general principles as the cornerstones of his approach to mental phenomena. It is on the basis of these that he develops his theories of the pathology and cure of insanity. Both principles are solidly materialist. The first affirms the dependence of mental life on sense experience of the external world. The second affirms the dependence of mental operations on motion within the brain. In short, there can be no mental activity without correlative activity in the senses and in the brain.

Thus, after enumerating the principal operations of the mind as sensation, perception, association, judgment, reasoning and volition, he says that they "have been called, very happily, *internal* senses." "They resemble," he continues, "the external senses in being innate, and depending wholly upon bodily impressions to produce their specific operations. These impressions are made through the medium of the external senses." The complete dependence of thought on sense experience is asserted: "As well might we attempt to excite thought in a piece of marble by striking it with our hand, as expect to produce a single operation of the mind in a person deprived of the external senses of touch, seeing, hearing, taste and smell."

Both this first principle and the second would appear to anticipate similar ones set forth by I. M. Sechenov in Russia half a century later. The second maintains, "All the operations in the mind are the effects of motions previously excited in the brain, and every idea and thought appears to depend upon a motion peculiar to itself. Not only mind in general depends on activity of the brain, but each mental operation depends on a special activity of which it is a function. The possibility of a science of mental life depends on the fact that "In a sound state of mind, these motions are regular and succeed impressions upon the brain with the same certainty and uniformity that perceptions succeed impressions upon the senses in their sound state."[1]

Starting with the premise that there is regularity and uni-

formity in the correlation between mental operation and motions of the brain, it is no wonder that Rush looked for the mechanism of mental illness in the malfunctioning of the brain; and he sought for cures in the re-establishment of healthy functioning of the same organ. This by no means meant that worry, grief, disappointed love, and mental stress of whatever other type could not be a cause of mental illness. But such causes, Rush maintained, act through the medium of the body and the brain, and only thus do they produce illness. "Madness," he says, "has been placed exclusively in the mind. I object to this opinion . . . because the mind is incapable of any operations independently of impression communicated to it through the medium of the body" and "I object to it . . . because there are no instances of primary affections of the mind, such as grief, love, anger, or despair, producing madness until they had induced some obvious changes in the body, such as wakefulness, a full or frequent pulse, costiveness, a dry skin, and other symptoms of bodily indisposition."

The "seat" of mental illness is the brain, not the mind. Derangement of mental processes is, therefore, based on a malfunctioning of physiological processes. Rush makes this very clear when, in answering an objection to his position, he states: "I know it has been said in favour of madness being an ideal disease, or being seated primarily in the mind, that sudden impressions from fear, terror, and even ridicule have sometimes cured it. This is true, but they produce their effects only by the healthy actions they induce in the brain."

With his firm rejection of the mind as the seat of mental illness, he proceeds to develop his own theory that "the cause of madness is seated primarily in the blood-vessels of the brain." The important thing, of course, is not his specific theory of the role of the blood vessels, but his general principle that "madness" is a derangement "affecting that part of the brain which is the seat of the mind." On the basis of this principle, Rush analyzes the causes of mental illness.

He distinguishes two causes of partial and universal madness: (1) those causes which "act *directly* upon the body," and 2) those which "act *indirectly* upon the body, through the medium of the mind. Since, according to Rush, the seat of mental

illness is the brain, it follows that disturbances of the activity of the brain can come either from physical causes acting directly on it or from the stresses and strains of mental life acting on it indirectly. The latter cause operates by means of the fact that, according to Rush's general psychological theory, all mental, intellectual, conscious operations involve correlative activity of the brain.

Among the causes of derangement which act directly on the body, are in the first place those which, Rush says, "act directly on the brain."* These are such conditions as lesions of the brain, tumors, abscesses, and water in the brain, apoplexy, palsy, epilepsy, and so forth. Then there are those "causes which induce madness by acting upon the brain in common with the whole body." Among these are: gout, dropsy, consumption, fevers of all kinds, the use of "ardent spirits," great pain, and unusual labor or exercise.

Finally, he points to "The causes which induce intellectual derangement by acting upon the body through the medium of the mind. . . ." Among these causes, Rush cites "intense study" particularly when it is study of "imaginary objects of knowledge." Such imaginary objects of knowledge "are, chiefly, the means of discovering perpetual motion; of converting the base metals into gold, or prolonging life to the antediluvian age; of producing perfect order and happiness in morals and government by the operations of human reason; and, lastly, researches into the meaning of certain prophecies in the Old and New Testament." Other causes which act on the body through the medium of the mind are: "Joy, terror, love, fear, grief, distress, shame from offended delicacy, defamation, calumny, ridicule, absence from native country, the loss of liberty, property, beauty, gaming, and inordinate love of praise, domestic tyranny, and lastly, the complete gratification of every wish of the heart." "Where," he says, "is the madhouse that does not contain patients from neglected, or disappointed love."

Rush, then, sees the causes of mental illness as any of innumerable physical or mental conditions, all of which act in such a way as to produce organic disorder or malfunctioning in the human brain. In each instance he cites a profusion of actual cases, either observed by himself in his long career both as a

private practitioner and as a member of the staff of Pennsylvania Hospital, or reported by other observers. Throughout the book it is clear that his theoretical principles are derived, not from armchair speculation, but as generalizations from practice.

A few examples from the many cases mentioned by Rush will serve to give the down-to-earth flavor of the book. Since he held that "intellectual derangement is more common from mental than corporeal causes," we will cite examples from that cause. "Terror has often induced madness," he says, "in persons who have escaped from fire, earthquakes, and shipwrecks. Two cases, from the last cause, have occurred under my notice." Again, "extravagant joy produced madness in many of the successful adventurers in the South-Sea speculation in England, in the year 1720." And again "The Africans become insane, we are told, in some instances, soon after they enter upon the toils of perpetual slavery in the West Indies." "Grief," he reports, "induced madness, which continued fifty years in a certain Hannah Lewis, formerly a patient in the Pennsylvania Hospital." Another, "An exquisite sense of delicacy, Dr. Burton says, produced madness in a school-master, who was accidentally discovered upon a close-stool by one of his scholars." "A clergyman in Maryland," Rush reports, "became insane in consequence of having permitted some typographical errors to escape in a sermon which he published upon the death of General Washington." Finally he says, "Hundreds have become insane in consequence of unexpected losses of money," and adds, "It is remarkable this disease occurs oftener among the rich, who lose only a part of their property, than among persons in moderate circumstances, who lose their all." In a lighter vein, speaking of celibacy as a cause of derangement, he remarks, "Celibacy, it has been said, is a pleasant breakfast, a tolerable dinner, but a very bad supper . . . no wonder it sometimes becomes a predisposing cause of madness."

One of the conclusions he drew from his experience was "The rich are more predisposed to madness than the poor, from their exposing a larger surface of sensibility to all its remote and exciting causes. Even where mental sensibility is the same in both these classes of people, the disease is prevented in the latter by the constant pressure of bodily suffering from labour,

cold and hunger. These present evils defend their minds from such as are past and anticipated; and these are the principal causes of madness. When it occurs in poor people, it is generally the effect of corporeal causes."[2]

In the course of three hundred and sixty-five pages, Rush not only describes and analyzes the symptoms and causes, corporeal and mental of some twenty-four types of mental illness and insanity, he also gives recommendations, based on his own clinical experiences and on study, for their treatment. In each case, he bases his recommendations for therapy on two principles, corollaries of those relating to causes. "The remedies," he says, "for . . . derangement divide themselves into two classes: I. Such as are intended to act directly upon the body; and II. Such as are intended to act indirectly upon the body, through the medium of the mind." Here once again he follows his general thesis that mental illness unfolds on a physiological canvas, that to treat the ills of the mind, therefore, one must employ measures which act directly or indirectly on the brain or the body as a whole in such a way as to restore them to a healthy state.

Among the measures designed to act directly on the body and brain, he recommends purges, emetics, a reduced diet, warm baths, cold baths, exercise—especially on horseback—labor, the excitement of pain, salivation, blisters, blood-letting; and the use of certain drugs and herbs.

Among the measures designed to act indirectly on the body or brain through the medium of the mind, he recommends: confrontation by reality and truth which shatter illusions; destruction of all old associations of ideas; removing external causes such as debt and ignorance; change of dress, habitation, company; certain amusements; music; matrimony when a patient is single; induced terror; traveling.

Here again, the significance of Rush's work does not lie in the specific recommendations but in the general principles he advances. Many of the therapeutic measures are outmoded but the approach remains highly fruitful. In general, Rush says that complete cure depends on "the removal of all the remote and exciting causes"[3] which have acted either "directly on the body" or "indirectly on the body through the mind."

Diseases of the Mind was, indeed, a pioneering work. At the time it appeared, a century and a half ago, information on the subject of insanity was practically non-existent. Mental illness was more often than not considered to be the work of the Devil. The insane were for the most part incarcerated with ordinary criminals, confined in almshouses or allowed to wander about at large. Doctors as well as laymen were almost wholly ignorant of the nature or seat of the illness. Against such a background Rush's volume marks a great stride forward.

But most important, *Diseases of the Mind* not only breaks new ground but at the same time lays an objective materialist basis for the further development of psychology and psychiatry. As far as they go, Rush's teachings are completely consistent with a materialist approach, such as was followed so brilliantly by Sechenov and Pavlov, respectively 50 and 100 years later. Rush taught with firmness and conviction that mental processes are a function of physiological processes, and that they are rooted in sense experience of the external environment. He saw that mental health involved three things: (1) proper living conditions; (2) proper functioning of the body and brain, and (3) true ideas and feelings in opposition to illusionary ones. In connection with the latter point, he cites as one of the major factors in preventing mental illness "filling the mind with that kind of knowledge only, which is supposed, or admitted to be true"; and conversely he deplores "the errors and falsehoods which are crowded into the memories of boys, in our modern systems of education."[4]

It is not surprising that a person who was active in the American Revolution, and active on three levels—politically, ideologically and on the battlefield—should subscribe to a materialist philosophy. Jefferson and Paine supply two other instances, but these are only the best known. Materialism, though in the form of deism (namely, that there is a God but he does not interfere with the processes of nature and history), was the dominant philosophy of the Revolution. Its primary target was the idealist doctrine of the divine right of kings. Rush was a deist, as many references in *Diseases of the Mind* attest. And yet his deist conviction in no way interfered with his scientific and materialist approach to medicine.

The fact, however, that materialism in deist form was the

dominant outlook of the anti-feudal and independence struggles in the eighteenth century, does not mean that Rush's writings on mental illness, or on medicine as a whole, were universally acclaimed. As a matter of fact, many if not most of the professional and wealthy people in Philadelphia were Tories, frightened by the "mob," as they called the common people, and by the ideas that moved them. He was throughout his life ostracized by the rest of his profession in Philadelphia. No physician, it is said, ever recommended a patient to him. He was advised time and again to give up his radical notions and above all to stop writing. But Rush was a man of uncompromising principles and to the end of his life he continued to challenge ignorance and oppression wherever he ran into them.

Diseases of the Mind was his last book, published just one year before he died in 1813. A letter he wrote to John Adams on November 4, 1812, enclosed with a copy of his book, indicates the kind of reception he expected from his colleagues. "My dear friend," he writes, "Herewith you will receive a copy of my *Medical Inquiries and Observations upon the Diseases of the Mind.* I shall wait with solicitude to receive your opinion of them. They are in general accommodated to the 'common science' of gentlemen of all professions as well as medicine. The subjects of them have hitherto been enveloped in mystery. I have endeavored to bring them down to the level of all other diseases of the human body, and to show that the mind and body are moved by the same causes and subject to the same laws. For this attempt to simplify the 'medicina mentis' I expect no quarter from my learned brethren. But time I hope will do my opinion justice. I believe them to be true and calculated to lessen some of the greatest evils of human life. If they are not, I shall console myself with having aimed well and erred honestly."[5]

On April 19, 1813, at the age of sixty-seven, Benjamin Rush died. His legacy of unremitting struggle for liberty and science belongs to the people. It is a heritage of which to be proud and on which to build.

James Rush

The first to build on the heritage of Benjamin Rush was his son, James. James Rush devoted his life to medicine and psychol-

ogy. In the latter occupation he has been almost completely neglected and remains all but unknown. His principal work is not to be found in the leading libraries, not even the Library of Congress. And yet this man carried forward the scientific spirit of his father.

James Rush was born in Philadelphia in 1786, one of thirteen children born to Benjamin and Julia Rush. After finishing school, he studied under his father at the University of Pennsylvania. In 1809, he went to Scotland to study at the University of Edinburgh. Upon returning to Philadelphia as a Doctor of Medicine in 1811, James Rush married Ann Ridgway, the belle of the city, and settled down to a lifetime of medical practice and of theoretical work in psychology.

His first major project was a volume on *The Philosophy of the Human Voice.* Written between 1823 and 1827, it was an experimental study of the physiology of speech, the muscular and nervous control of the vocal cords. When no publisher could be found, he had it printed at his own expense. It was the standard work on the subject for some fifty years, in that time going through seven constantly expanded editions.

Even before he began his work on the human voice, he had written, in 1818, a preliminary sketch of what was to be his major work, *An Analysis of the Human Intellect.* It was an outline of a new approach to psychology, and he regarded his study of voice as a first part of this larger undertaking. For forty-seven years he collected material and made notes, and finally in 1865, when he was seventy-nine, his magnum opus was published. It is a militant attack from a materialist point of view on the theologians and metaphysical philosophers who then completely dominated the field of psychology. The classic nineteenth century title sets the tone of the two volume, 900-page work: *Brief Outline of an Analysis of the Human Intellect; intended to Rectify the Scholastic and Vulgar Perversions of the Natural Purpose, and Method of Thinking; By Rejecting Altogether the Theoretic Confusion, The Unmeaning Arrangement, And Indefinite Nomenclature of the Metaphysician.*[6]

James Rush was fully aware of the complete break he was making with current thought by viewing the human mind as matter so organized that it can think. In his preface to *The*

Philosophy of the Human Voice he had given "the majesterial pretenders to intelligence fifty years to comprehend . . . this work." But in the Preface to *An Analysis of the Human Intellect* he says that the author "finds he mistook their capacity. In this Second Part, he will be more liberal: for as it uproots so many of the notions, habits, and prejudices of the narrow and stringent Lawgivers of Thought, he here allows them three hundred years to clear away their piles of rubbish, and to try to reconcile themselves jointly, both to the First part and to it." It is understandable that Rush felt isolated and misunderstood, that he felt he was writing for some distant posterity. Certainly the dominant temper of his time gave him little if any ground for confidence, or hope of intellectual fellowship. It must have appeared to him that his conviction that mind could be understood only in terms of the senses, the brain, muscles and language, and that its function was to produce a truer reflection of the world, was held only by him and that therefore he was a lone wolf with no support.

But had he known his Marxist contemporaries such as Joseph Weydemeyer or Frederick Sorge in his own country, or Sechenov in Russia, or Marx and Engels in England, he would have been spared his moods of isolation, scepticism and bitterness. Conversely, had these men known the work of James Rush, they would have welcomed it wholeheartedly, as they did all evidence of materialist thought. The closest intellectual kin Rush had in his own time was Sechenov. There is a very close parallel between the works of the two men in the field of psychology. And their major books appeared in their respective countries less than two years apart: *An Analysis of the Human Intellect,* 1865; *Reflexes of The Brain,* 1863.

That Rush was an avowed materialist is made already unmistakable in the descriptive heading of his Introduction: "Describing the two different Methods of using Mind; the Physical or Material; and the Metaphysical or Spiritual: together with the influence of the latter in hiding, under a cloud of ignorance and confusion, the true and beautiful history of the Physical Mind." What he means by "physical mind" is indicated in the opening sentences. "All that man perceives, thinks, pronounces and performs," he says, "is respectively through his senses, his

brain, and his muscles. From these physical and directive agencies proceed his science and his art; and from their proper or improper use, severally arise his good and his evil, his error and his truth." He accounts for mental phenomena as functions of matter highly organized into the senses, the brain and the muscles. Thus he finds no necessity for the supposition of an incorporeal, immaterial substance such as soul or spirit.

As a matter of fact, Rush says, the decisive thing which has held man back in his attempt to understand consciousness is the almost universally held notion that there are two substances, matter and spirit. Natural science investigates matter by the experimental method, he says, but metaphysics *discourses* on the spirit by means of contemplating consciousness from an armchair. If mental phenomena are to be understood scientifically, we must "learn that the origin of the false distinction between matter and spirit did not rest upon a real difference in the constitution of the universe of things, but on an ignorance of their Unity." And he goes on to say that while science has made great strides in the discovery of the nature of the material world, "the metaphysical inquiry into the actions of the spiritual mind . . . has produced little more than doubt and controversy. And such will be the sad result so long as the mind is assumed to be different in its frame and actions from those of a refined and concealed material organization; or until its frame and actions are subjected to physical investigation."

Throughout his book, Rush develops these two main themes: one, that metaphysics, or idealism, has acted chiefly to obstruct man's knowledge of mental life; and two, that to understand mind it is necessary to explore how matter, in the form of the human organism, can think, feel and be conscious. He draws up a strong indictment of metaphysical idealism in developing the first theme. He lists six ways in which "metaphysics . . . has obstructed the investigation of the physical phenomena of the senses and the brain."

First, metaphysics "has created a belief that Mind, being a different *entity* or existence from Matter, they severally require a different process of investigation: one to be conducted by the senses and the brain; the other by the spiritual mind and contemplating only itself, thus rejecting those observative and

experimental means which have produced the abundant truth of demonstrative science." Here Rush formulated the central question confronting psychology, from his own time down to the present. It is the question of exploring mental life by the objective scientific method or by the idealist method of introspection. Sechenov was posing the identical question at the same time. And it was this question which confronted Pavlov in 1903. All three side with science against introspection, but Sechenov and Rush could only theorize on what such a scientific approach should be. Neither science nor society had advanced sufficiently by the middle of the nineteenth century for them actually to carry on the investigation of psychic life by the experimental method. That was Pavlov's task, forty or fifty years later. Freud and William James, on the other hand, chose the metaphysical, idealist method of introspection so sharply attacked by James Rush.

The second way in which metaphysical introspection obstructs the scientific investigation of the senses and the brain is, according to Rush, its "fictional method." "Observation," he says ". . . being confounded by its mystical associate, gives way to conjecture and thereby perverts or falsifies the true history of mind." Not fact, but fiction, and therefore falsification, is the product of the metaphysical approach. And falsification is the obstruction of science.

Third, authority tends to take the place of observation and experiment in the metaphysical method. "The mind in the uneasiness of a metaphysical doubt, seeks relief in authority. In this way professional schools, and renowned individuals become the directors of fictional belief. . . . The authority of these schools and individuals having been derived from authority, and this again through previous authorities, from its fictional origin, can never end in the unalterable satisfaction of physical truth." "And let us learn," he adds, "there is more rejoicing hope in the kingdom of Truth over one Fact of physical experience, then over all the endless Promises of notional metaphysicians who know and care not what a productive physical observation means." In his indictment of the metaphysical approach to mental phenomena, Rush had in mind primarily the theologians and the idealist philosophers, but the history of modern psychol-

ogy, with its endless *schools* centering around "renowned individuals," is equally pertinent. When there are few if any "unalterable" scientific facts and laws which are generally accepted, then there will be a profusion of individual points of view gravitating around *authorities,* each equally "authoritative."

The fourth way in which metaphysics obstructs the science of the psyche, is, Rush charges, by the authoritative assumption that it is "the more dignified and profound method of investigation, and therefore better adapted to reach the mysterious depths of this important subject." But lying behind this assumption is the "mental indolence" which "learned by short experience that the acquisition of knowledge through the senses is a slow and laborious process, and thus found it easier to guess at the course of causes and effects than to discover them." This method of guessing instead of experimenting originated, Rush says, with the idealist philosophies of Greece and Rome, was taken over by the Catholic Church, and "continues to be the exclusive mode of inquiry into the supposed spiritual character of the mind." And he concludes in a burst of indignation, "This is the arrogant assumption of dignity and power, by metaphysical pride, that in its driveling imbecility, intolerantly denounces every attempt to treat the mind as if it were a fact of universal physical nature."

In the fifth point of his indictment of metaphysics, Rush opens an all-out attack on "theology and the Church," "those passions of Fanaticism, Avarice and Pride" which have "tended perhaps more than any other cause to prevent the physical development of the human mind." Every theology and every church, he says, no matter how they have differed and warred on other doctrinal points, unite as one behind the notion of the spirituality of mind. And not a single church or theology "has in any age allowed Physical Science to touch its metaphysical belief" nor will it ever "allow the spreading light of physical science to come near it." "Theology," he says, "and its ambitions associate the Church, with the interests of its worldly establishments, being always fearful of even remote consequences, has never looked upon independence of opinion without suspicion and threat. The mere hint of applying physical science to the subject of mind has been considered by Church-men and Theologians as the unpardonable sin. . . ." He speaks of "the

part that an inquisitorial Church and a notional Theology have taken in preventing a proper and successful investigation of the mental functions of the brain," and then remarks "I have said enough on this point to raise an argument, if not something worse; but I will not prepare for either—Could a controversial Metaphysician bring before my senses the smallest fraction of the least atom of an immaterial mind, I might be induced to try an argument. . . ."

The sixth and final point in Rush's indictment of the metaphysical approach to mental life is in reality a corollary of the fifth. He points out that scientists long ago might have applied the objective, experimental method of science to the study of the human mind if they had not been intimidated by theology and church with the power of social ostracism and worse. "How then can the scientist hope for safety if he attempts to undermine at least one of the towers of metaphysical Theology, by questioning its notion of spirituality in the mind?" Thus, the metaphysical method, backed by theology and the church, has prevented scientists from the serious study of the material processes underlying thought and feeling. So powerful is this influence that James Rush's book itself has been effectively buried. Today it is all but impossible to find a copy anywhere in our country.

Rush concludes his indictment of the introspective, metaphysical method in psychology: "This is the nothing-meaning, and the reality-mischief of that celebrated word metaphysics which has so distracted the thoughts and purposes of mankind, which, with a pretension to great profundity, has so long deluded those who do not see through its shallowness; which has turned aside inquiry of our physical nature, to something that nobody can realize into fact; and which to bring it down to our present subject, has taken the place of proper physical inquiry into the working plan of the material organization of the human mind."

Thus there are two methods in approaching mental life: "The one ascribes a material and mental energy to the senses and the brain. The other assumes that agency to be directed by an immaterial spirit." The trouble is that there is an "overbearing influence of the latter opinion" which "has done everything within its effective if not deliberate effort to prevent a

proper physical investigation from having long ago been made and described with the plainness and accuracy of other phenomena in Natural Philosophy." There is, however, "but one mode of gaining knowledge of parts of the universe . . . the mode of observation and experiment." "The physical investigation of things may indeed be slow," Rush says, "but it is cautious and sure." And finally, he expresses his unbounded faith in science, "Physical science has by itself told us much, and will by undisputing inquiry gradually tell us everything that is to be known."

With this militant introduction, James Rush proceeds to the business of outlining "the Working Plan of the material mind."[7] But here he is confronted by a contradiction. He has maintained that only by experiment can science discover this "working plan" of the mind. But he, and scientists of his time, had no experimental method for discovering the facts and laws of higher nervous processes. Thus he was forced to proceed by theorizing just as I. M. Sechenov had to do. And yet again like Sechenov his theorizing was close, in a general way, to the conclusions later reached experimentally. Theorizing, starting from a materialist position and carried forward by careful observation, can be something quite different from metaphysics. It can be establishment of a scientific hypothesis, and as such may be an important step in the development of a science.

It is impossible here to give more than a brief summary of Rush's attempt to present "the working plan of the material mind." He develops it in some 900 pages of closely packed reasoning, analogies and examples. The complete work would be worthy of careful study if it were only available, by all who are seriously concerned with the development of the sciences of psychology and psychiatry.

The first step for Rush was to define "mind to be exclusively a physical function of the senses and the brain."[8] He cannot prove the truth of this definition by experiment, for that had to wait until the discovery of the theory and method of conditioned reflexes. But he produces what he calls "presumptive evidence" by two means. First, he exposes the metaphysical doctrine of the immateriality of mind, as indicated above. Second, he infers the definition from the history of all the other sciences, where prog-

ress was made only after spiritual causes were ruled out and sole attention was given to matter and material causality. If psychology is to be a science in company with other sciences, it must reject the dominantly held notion that mind is independently immaterial, and view it rather as a function of matter organized in the form of the senses and the brain. If people do not agree with this, he says, he will not argue with them. He will ignore them and proceed with the development of the science, as all true scientists have done down the ages.

The second step is to establish that the functions of the senses and the brain "appear under the form of Perceptions, which are representative images and types of natural things." Here he sets himself the task of answering the question, "Can matter be conscious of itself." And he says, "Before the materialist can answer this, he must be told what consciousness is, which the spiritualist cannot inform him." For a materialist, he says, the question must be put this way: "Whether matter can reflect?" "To reflect," he continues, "when understood of the senses and the brain, is to have image or type represented or impressed upon them." The senses, particularly the retina of the eye, can have an image impressed on it, as the science of optics proves. And, says Rush, "we find no objection to the admission that the structure of the brain, however minute its organic cells or atomic granules, for nature never stops at subtlety, may be clear points for reflecting those images and types of things." His conclusion is that "sensuous and cerebral matter under some of its peculiar forms or conditions can reflect or perceive an object." Since reflection in the human mind is consciousness, matter can be conscious of itself. Thus does Rush develop the reflection theory of consciousness, which is a vital aspect of the science of psychology.

The third step, according to Rush, is to answer the question, "What can reflection or perception of objects on the brain effect?" "It is readily answered," he says, "reflections and perceptions do the important work of Thinking." To think is to compare perceptions of objects, to mark their similarity and differences and to draw other inferences and conclusions from them. Without sense images, and without their cerebral reflections, there would be no thought. But thought is not possible solely

with perceptions. Something else is required. And here Rush makes a profoundly materialist contribution.

The fourth step is the recognition of the role of language, silent, spoken and written, in the process of thinking. "Without the use of the verbal sign, to reimpress and to rouse the quiescent images and types of the senses and the brain, through the ear, by a sound significant of their unnamed and therefore feeble perceptions, and then to communicate them to others, the human mind would be as limited, and unimprovable as that of the sub-animal." Unspoken thought is the use of "silent verbal signs" by means of "association." Communication of thought is the use of spoken or written verbal signs. Thus without language there can be no thought. "The working powers of the mind," he says, ". . . are derived from the physical functions of the senses and the brain, assisted by the verbal sign."

With these four steps in his outline of "the working plan of the material mind," Rush established himself as one of the pioneers of a materialist approach to psychology. Consciousness, thought, all mental phenomena are viewed as functions of the senses and the brain, and as reflections, with the indispensable aid of language, of the external world. "Thus what we call the mind," he says, "is the representation of the external world by physical images and types on the senses and the brain, and by the descriptive powers of language."[9] He leaves big gaps, but they are gaps which themselves help to point the way for science to fill them in.

He concludes his work with the following statement:

"I have at last finished the Outline of an Analysis of the Human Intellect . . . and have endeavored to point out the natural purpose and method of thinking. . . . We proposed, and believe we have executed, with whatever degree of success, an inquiry into the mind as if it were a physical function of the physical senses and the brain. As far as we have read, and heard, the attempt is, in its own way, altogether new. . . . And though the opinion of the materiality of the mind is at least as old as the time of Democritus and Epicurus . . . yet modern writers have . . . generally founded their inquiries on its spirituality. . . . Having rejected the notion of immateriality, we no more suffered metaphysics, religion, popularity, conformity, or any

other inapplicable motive, to interfere with our physical investigation, than the chemist would allow these same motives to thwart his analysis of a newly discovered ore. . . .

"We began with the purely physical method, and continued it strictly to the end of our purpose. If it has produced any truth worthy of cultivation . . . it is principally owing to fixing our observation and contemplation on Nature alone, not believing there is anything else to be perceived, before, above, beneath, or beyond her. . . .

"But we leave these important subjects to the observation and reflection of a wiser world, when it has come to believe the things we have told . . . and in a vision of more than ambitious glory, upon an unparalleled reform, to try the last though forlorn hope of a rectified Intellectual Revolution."[10]

Rush looked in the dim future for a restoration of materialism, but in his isolation, felt that it was a forlorn hope. What would he think today, ninety years later, when nearly one-half of the world lives in an atmosphere, not of metaphysical idealism, but of dialectical materialism, among the aspects of which is an unalterable affirmation of the very principles he set forth.

James Rush died in 1869, just four years after the publication of his major work. There may be some question whether he can be ranked with Sechenov. But there can be little doubt that he should be considered the father of materialist psychology in our country, just as Benjamin Rush is recognized as the father of materialist psychiatry.

Behaviorism

The Rushes, Benjamin and James, together furnish a solid materialist foundation for the development of objective psychology in the United States. However, what of necessity was missing with them was experimentation. The first use, in this country, of the experimental method in the study of animal behavior took place in the 1890's, and the first book-length report of such experiments was written by Edward L. Thorndike and published in 1898.[11]

Thorndike's *Animal Intelligence* marks a turning point, not only nationally but internationally, in the development of the science of psychology. Here for the first time was an attack on

the introspective, subjective approach through scientifically controlled experiments. Pavlov recognized this when in 1923 he wrote: "Some years after the beginning of the work with our new method I learned that somewhat similar experiments on animals had been performed in America, and indeed not by physiologists but by psychologists. Thereupon I studied in more detail the American publications, and now I must acknowledge that the honour of having made the first steps along this path belongs to E. L. Thorndike. His experiments preceded ours by two or three years, and his book must be considered as a classic, both for its bold outlook on an immense task and for the accuracy of its results."[12]

Animal Intelligence opens with an attack on introspection. "On the whole," writes Thorndike, "the psychological work of the last quarter of the nineteenth century emphasized the study of consciousness. . . . There was a tendency to an unwise, if not bigoted, attempt to make the science of human nature synonymous with the science of facts revealed by introspection."[13] He maintains that as long as introspection remains the chief method of psychology, there can be no hope of it becoming an experimental science. His own experiments convinced him that psychology could become a science only by objective experimental investigation of behavior, an investigation and method which would be continuous with physiology. "This essay," he says, "will attempt to defend these positions and to show further that psychology may be, at least in part, as independent of introspection as physics is." For him, psychology is the study of the nature of man through the study of human behavior. And "behavior includes consciousness *and* action, states of mind *and* their connections."

Thorndike devised an experimental method by means of which to study behavior. His experiments, reported in *Animal Intelligence,* were with cats, dogs and baby chicks. His method was to place a half-starved cat, dog or chick in a problem situation, the problem being to manipulate a simple mechanical latch which would open a door and allow them out of a box to get at visible food. The animal was put in the box, food was left outside within sight, and his actions recorded. Besides observing his general behavior, special notice was taken of *how*

he succeeded in doing the necessary act, in case he did succeed, and a record was kept of the time that he was in the box before performing the successful clawing or biting. The animal was put in the box once a day repeatedly until "he had formed a perfect association between the sense-impression of the interior of the box and the impulse leading to the successful movement. If, however, the animal after a certain time, did not succeed, he was taken out, but not fed. If, after several trials, this did not work, if he continued to fail, the case was recorded as one of complete failure.

The experiment was designed to answer the question "whether an animal does or does not form a certain association." What the cat, dog or chick had to do was to make "the connection of a certain act with a certain situation and resultant pleasure, and this type of association is found throughout the animal's life normally."

Descriptively, the results of the experiments were identical in general form whether the subjects were cats, dogs or chicks. The animal made persistent but completely random efforts to get out, in the course of which, sooner or later he might accidentally accomplish the necessary act to open the door. Once having succeeded, in subsequent tests he still went through random behavior but for a shorter time. Eventually, through trial and error, he eliminated the random activity and straightway accomplished the act. All this, of course, took place within the same problem situation, in the same box. When confronted with a new situation the entire process had to be repeated.

Thorndike draws several conclusions from these experiments, all of which combine to disprove the traditional introspective interpretation of animal behavior in terms of reasoning, having ideas and association of ideas, wishing, desiring or learning by imitation. The fact that animals solve problems solely by random activity and resultant accidental success, he felt, was sufficient to completely discredit the subjective approach. Experiment, not introspective speculation, alone can furnish the truth of animal behavior. "Surely," he says, "every one must agree that no man now has a right to advance theories about what is in animal's minds . . . unless he supports his thesis by systematic and extended experiments."

From his own experiments, he concludes that the animal "does not look over the situation, much less *think* it over, and then decide what to do. It bursts out at once into the activities which instinct and experience have settled on as suitable reactions to the situation 'confinement when hungry with food outside.' It does not ever in the course of its successes realize that such an act brings food and therefore decide to do it and thenceforth do it immediately from *decision* instead of from impulse." Finally he says, "I may add that my observations of all the conduct of all these animals during months spent with them, failed to find any act that ever *seemed* due to reasoning. I should claim that this quarrel ought now to be dropped for good and all—that investigation ought to be directed along more sensible and profitable lines."

Even more important than this general conclusion on the futility of introspection as compared with experiment, is Thorndike's attempt to indicate the mechanism of animal behavior. Here he begins to point however vaguely in the direction of the conditioned reflex. "The one impulse, out of many accidental ones, which leads to pleasure, becomes strengthened and stamped in thereby, and more and more firmly associated with the sense-impression of the box's interior. Accordingly it is sooner and sooner fulfilled. Futile impulses are gradually stamped out. The gradual slope of the time curve, then, shows the absence of reasoning. They represent the wearing smooth of a path in the brain, not the decisions of a rational consciousness." The general outline of a mechanism for "stamping in" and "stamping out," within the framework of "the wearing smooth of a path in the brain," roughly foreshadows the later work of Pavlov.

Had experimental psychology in the United States followed this lead, had it gone on to investigate how paths are "worn smooth" in the brain, and what were the laws of "stamping in" and "stamping out" connections, American psychologists would have been in a position to welcome the work of Pavlov and his colleagues and to help develop the scientific investigation of higher nervous processes. But this was not to be the case.

Instead of seizing on this aspect of Thorndike's pioneering work, attention was concentrated on external behavior for the practical purpose of controlling it. Thorndike himself, had

already in *Animal Intelligence* a strong tendency toward this approach. For one thing he maintained that "there can be no more warrant for studying man's nature unless that study will enable us to control his acts."[14] For another, his preoccupation with problem-solving through the use of rewards and punishment, pleasure and pain, success and failure, tended to point toward practical tasks of how animals and people could be conditioned to respond in desired ways, rather than to the scientific discovery of the laws of the central nervous system.

Thus Thorndike's *Animal Intelligence* pointed in two directions, but not equally. The strongest tendency was the practical rather than the scientific. However, Pavlov greeted this work for the positive values it embodied: first, it was experimental, second, it did, on one side, point in the direction of scientific progress; third, it explicitly attacked the subjective, introspective method.

But Pavlov also saw its weaknesses. Writing in 1923, he said: "The Americans, judged by the book of Thorndike, set out on this path of investigation in quite a different manner from us. From a passage in Thorndike one may conjecture that the practical American mind applied to everyday life found that it is more important to be acquainted with the exact outward behavior of man than with guesses about his internal states with all their combinations and changes. With these considerations concerning man, the American psychologists proceed to their laboratory experiments on animals." Pavlov recognized that this immediate practical objective was quite different from his own concern with the development of the science of higher nervous processes. "I and my co-workers," he writes, "hold another position. . . . The methods and the conditions of our experimentation, as well as the scheme of the separate problems, the working up of the results, and finally their systematization—all this has remained in the realm of facts, conceptions and terminology of the central nervous system. This approach to our subject from both the psychological and physiological sides enlarges the sphere of the phenomena under investigation."[15]

The stress on practical control of behavior, rather than on the nervous processes underlying mental activity, was seized on by American psychologists and developed into the school of psychology known as *behaviorism*.

Behaviorism reached its peak in the 1920's. Its chief spokesman was John B. Watson and his major work was *Behaviorism,* published in 1924. By that time the conditioned reflex had been taken over from Pavlov and assimilated to meet the needs of behaviorism. Instead of being the mechanism of higher nervous processes, it was employed as the mechanism of behavior and its control. It became a purely mechanical device to achieve a desired response from a given stimulus. So far was this carried that many of the concepts of psychology were dispensed with, including consciousness, perception, will. In its extreme form the claim was made that, with a few months *conditioning,* the whole personality of an individual could be made over.

So *practical* did behaviorism become that it has largely disintegrated as a school of psychology, and has been incorporated in such undertakings as advertising and propaganda, intelligence and vocational tests, and indoctrination of all kinds.

Symbolic of this is what Thorndike and Watson did with their lives. Shortly after the publication of *Animal Intelligence* Thorndike went to Teachers College, Columbia University, and devoted his energies to the development and application of intelligence testing. He was in charge of testing Army Personnel in the First World War with all its class and racist results. Watson was forced to give up experimental psychology and became an advertising executive, where he applied his theories and methods more lucratively.

Outlook for Materialist Psychology and Psychiatry in the United States

The writings of Benjamin and James Rush and the early experimental work of E. L. Thorndike comprise a sound heritage. But heritage is clearly not enough. The outlook for a materialist approach in American psychology and psychiatry involves not only heritage but actual situations which can move the two sciences forward. What is the current state of affairs in psychology, in psychiatry, and, it should be added, in the physiology of the nervous system, which appear significant for the development of a materialist orientation in these fields?

First, what is the situation in the physiology of the nervous

system which may prove significant for the development of materialist psychology and psychiatry in our country?

By far the outstanding American text in the field today is *Physiology of the Nervous System* by John Farquhar Fulton, Professor of Physiology at Yale. The body of the work deals with the organization and function of the various parts of the brain, from the Medulla Oblongata to the Cerebral Cortex, and shows the great progress made in knowledge of the separate parts. The book was first published in 1938 and was revised in two later editions, the last in 1949. The situation in the physiology of the nervous system is dramatized by the difference between the final chapter of the 1938 edition and that of 1949.

The closing chapter in both editions is entitled "The Nervous System as a Whole." In 1938 Dr. Fulton was able to devote only one and one-half pages to the entire chapter. The burden of what he then had to say was that the physiologist could analyze the nervous system and particularly the brain into its parts and identify many of the separate functions, but could not as yet "build it up again into an integrated whole." And he concluded, "Mental experience still eludes analysis in terms of reflex action. Yet there is little doubt in the mind of any neurophysiologist that mental phenomena represent some feature of the organization of nerve cells. . . . The elucidation of mental phenomena, normal and abnormal, still remains the most challenging problem of neurophysiology. Some believe that we are nearer a rational explanation of the mind than we were fifty years ago, others do not."[16]

In the 1949 edition, however, Dr. Fulton expanded the one and one-half pages to thirty-one. Even more significant, he added a sub-title to the chapter head, "The Nervous System as a Whole: The Conditioned Reflex."[17]

Here a singular historic fact must be noted. Whereas American psychology early adopted aspects of Pavlov's method of the conditioned reflex, as we have seen in the case of behaviorism, American physiology seems to have been very little if at all influenced by it. Thus Dr. Fulton, evidently recognizing that the key to understanding the nervous system as a whole was the conditioned reflex, but himself not having been trained in the Pavlovian science, asked the experimental psychologist, Dr.

H. S. Liddell of Cornell, to write the final chapter for him.

Dr. Liddell gives a summary of Pavlov's method of experimental research by means of the conditioned reflex, including the phenomena of experimental neuroses and the conditioning of internal bodily functions. He concludes his summary by pointing out that psychologists can investigate behavior by means of the conditioned reflex but must refer all basic questions ultimately to neurophysiology, the strong implication being that it is high time American neurophysiologists should master the teachings of Pavlov and thereby be in a position to give American psychologists the scientific facts and laws they so urgently require for the explanation of mental life.[18]

The current situation in physiology which enhances the outlook for materialist psychology and psychiatry in the United States is symbolized by the fact that the leading writer on neurophysiology indicates that the main hope for knowledge of the nervous system as a whole lies in the Pavlovian science of higher nervous activity. This recognition is a long and tremendously significant step in our country toward a fully materialist and scientific approach to the human mind.

Next to be considered is the situation in psychology which may be significant for the development of a scientific materialist approach in the field.

The most striking feature of American psychology is its experimental character. In his *History of American Psychology,* A. A. Roback says, "The *chosen* branch of psychology, as may be surmised, is experimental psychology. . . . The name of the experimenters is legion."[19] Ever since the separation of psychology from philosophy at the turn of the century, work in the field has been predominantly experimental, no matter in what branch nor what systematic interpretation was employed. The laboratory is, and has been, the center of Academic work in American psychology.

The psychological laboratory in the United States has concentrated more and more on elaborate "apparatus rigged up in technological fashion," as Roback puts it. In this experimental work animals such as rats, mice, cats, dogs, chicks and hamsters are the most common subjects. Each year a vast number of highly specialized reports of these experiments are pub-

lished in technical journals, many of them dealing with minutely detailed aspects of such subjects as sensation, imagery, memory, the emotions, volition, learning, abstraction, conditioning and the like. Sometimes as many as twenty-five years are spent in the establishment of a single experimental fact in which exhaustive checks are made to eliminate anything that might mar the objective results. Literally thousands of trained scientists and technicians are carrying forward this meticulous work in laboratories across the nation, and are amassing a great wealth of as yet largely unrelated facts.

Here again there is a peculiar situation. While much of the experimental work is based ultimately on the *method* of conditioned reflexes originally developed by Pavlov, the one *theory* that could bring the findings into relation with one another, and the one theory that could guide the experiments, is either rejected or unknown, or perhaps rejected because it is unknown. Pavlov's *method* has had a profound effect on American psychology, but his *theory* of the conditioned reflex, the theory which holds that the conditioned reflex is to the science of the brain what the atom is to physics and the value of a commodity is to political economy, remains without real influence in our country.

This emphasis on Pavlov's experimental method to the exclusion of his theory holds essentially true even for those laboratories which explicitly avow their allegiance to the Pavlovian teachings, such as those under the leadership of Dr. Gantt at Johns Hopkins, Dr. Masserman at Chicago and Dr. Liddell at Cornell.

In general, experimental psychology in the United States is today far more concerned with technical laboratory procedure than with basic theory. Statistics is in many cases substituted for theoretical interpretation. On this important point, Roback says: "Theory, at present, occupies less place in psychology, as compared with the past, and where it does enter, it seems to be confined to some specific account, usually by means of diagrams, of the *modus operandi* of some behavior. . . . In the interpretation of experimental results, statistics has now taken the place of theoretical considerations. It may be said that statistics is on the point of dominating all experimental work."[20]

The stress on technique in experimentation is at once both an asset and a liability for American psychology. It is an asset in producing highly trained laboratory workers imbued with respect for objective facts and contempt for the system-building and the introspective fantasies of the armchair psychologist. But when it is coupled with exclusion of scientific theory, it tends to leave the uninterpreted findings fair prey for the speculations of the very same armchair philosopher-psychologists whom the experimenters hold in such scorn.

The situation in American psychology which may lead to a fully scientific materialist approach is this discrepancy between actual experimental work, much of it based on the methodology of Pavlov, on the one hand, and the lack of a theoretical framework which alone could guide the research and unify the findings. In short, there is a contradiction in American psychology between the highly developed experimental practice and the lack of scientific theory which could interpret the amassed but relatively isolated facts.

Statistical relationships are a poor substitute for the true interconnections between facts. The pressure of the facts themselves, together with the dissatisfaction inevitably accumulating on the part of trained and sincere scientists, must lead sooner or later to a search for that scientific theory which can bring the facts into one integrated approach to the subject. The Pavlovian science of higher nervous activity, with the conditioned reflex as its basic concept, is the only theory which was developed exclusively out of experimental facts and which can both guide further work and bring all the discovered facts into one integrated view of human behavior. To resolve its internal contradiction between experimental practice and lack of scientific theory, American psychology must move in the direction of the Pavlovian science of higher nervous activity. Since the American experimental methods depend generally on the techniques developed by Pavlov, the essential truth is that the *method* of the conditioned reflex requires the *theory* of the conditioned reflex. At such time as American experimental psychology accepts the theory of the conditioned reflex, it will at the same time furnish its experimental technique with the guidance so lacking at present.

There are of course powerful factors at work to prevent the resolution of this internal contradiction between method and theory in American psychology. As long as experimental method can be kept divorced from scientific theory, all the experimental work done cannot hope to stem the tide of introspective-subjective psychology gravitating around Freudianism. As a matter of fact, lacking a fully scientific outlook, the experimental findings tend to become distorted into serving the interest of the current dominant ideology.

In 1886 John Dewey wrote a textbook of *Psychology* which today appears almost as a working formula for assuring the subservience of American experimental psychology to reaction, professional and political. In the text he defines psychology as the study of consciousness which, being for him always individual, can be investigated effectively only by looking inward to one's own self-consciousness, by introspection, that is. *"Psychology,"* he says, *"is the science of Facts of Phenomena of Self.* . . . Now, a fact of psychology does not thus lie open to the observation of all. It is directly and immediately known only to the self which experiences it. It is a fact of *my* or *your* consciousness, and only of my or yours. . . . The study of consciousness itself must be the main source of knowledge of the facts. . . . The study of conscious facts with a view to ascertaining their character is called introspection. . . . This method of observation of facts must *ultimately* be the sole source of the *material* of psychology."[21] According to Dewey, the only possible method for psychology is in the last analysis not experimentation but introspection.

Dewey, however, did not stop there. He calls Introspection the *ultimate* sole source of psychology because it has aids to help in its work. Among these aids he lists experimental and physiological psychology. "These various methods," he says, "accordingly, are not so much a departure from self-consciousness, as a method of extending self-consciousness and making it wider and more general."[22] Thus the objective experimental approaches to psychology are, for Dewey, merely supplements to the one indispensable method of introspection.

When psychology has no scientific theory based on its own experiments, laboratory facts do indeed tend to be subordinated

to introspective speculations of armchair psycho-philosophers. Thus Dewey furnishes a philosophical justification of what in fact has been the situation in American psychology for over half a century. His is a formula for maintaining the status quo, the subservience of experimental psychology to metaphysical psychology.

The contradiction between experimental method and lack of scientific theory is the situation which can lead to the development of a thoroughly scientific and materialist psychology in the United States. But it will take persistent struggle against the forces which have a high stake in perpetuating the relative ineffectiveness of experimental psychology through freezing it in its current contradictory state.

Finally to be considered is the situation in American psychiatry which appears significant for the development of a scientific materialist approach in the field.

One Hundred Years of American Psychiatry, the commemorative volume published for the American Psychiatry Association by Columbia University in 1944, outlines the history of psychiatry in the United States. It is a highly interesting story.

Throughout the nineteenth century the dominant approach by far was that summarized by Dr. E. Stanley Abbot as late as 1902, and which he claimed expressed the opinion of "the majority of psychiatrists today": "Insanity is a brain disease since it is a logical and self-evident consequence that the organ which under normal conditions subserves the purpose of psychical processes must be the seat of changes if these functions are disordered."[23] This was directly in the tradition of Dr. Benjamin Rush. But whereas Rush had included psychogenic as well as somatogenic types of mental illness, the tendency in the past century was to reduce all forms to the organic type. Brain lesions of one kind or another were considered as the sole cause. Neuroses were generally viewed either as products of as yet undiscovered lesions or as no disease at all, in which event neurotics were branded as malingerers.

Psychiatry in the nineteenth century, then, was dominated by what philosophically is called a mechanical materialist approach. Its slogan was: no organic lesion of the brain, no mental illness. But since no lesions whatever could be discovered in

cases of neuroses, there was an Achilles heel in this approach. The history of thought shows over and over again that a mechanical materialist view is usually followed by an idealist outlook which exploits the weakness inherent in the former. American psychiatry was no exception. Since no lesions could be found as the cause of neuroses, the opening of the twentieth century saw a whole host of "schools" of psychiatry claiming to have found the cause of neuroses in purely psychological or mental phenomena, and the treatment in equally pure psycho-therapy. One of these schools, the one destined to win out in the market place of psycho-therapies, was Freudianism which saw the mechanism of neuroses in a mental process called *repression.*

Psychoanalysis, analysis of the psyche or introspection, whether Freudian or not, became, after the First World War, the dominant trend in American psychiatry, and psycho-therapy became the main form of treatment. Thus the pendulum had swung full arc, from the mechanical brain-lesion approach to the introspective-idealist view. The latter, however, did not by any means completely displace the former. Many psychiatrists, particularly those whose practice was carried on in hospitals and clinics rather than in offices, continued to view the brain as the organ involved in all forms of mental illness, and the cure to lie in restoration of healthy cerebral functioning. Today these brain-oriented psychiatrists still comprise at least half of the total number of their profession.

This brain-oriented half of the psychiatric doctors is the source of most of the physical and pharmaceutical forms of treatment developed over the past two or three years, such as electric and insulin shock treatment and the so-called miracle drugs, especially chlorpromazine. But here we see the results of a mechanical, one-sided approach. Without a fully scientific and comprehensive theory of mental illness, one including both the organic and functional types, even the physical and pharmaceutical therapies tend to be subordinated to the introspective psychotherapeutic approach. Thus in the case of both shock treatment and treatment by such drugs as chlorpromazine, the tendency is to employ them as means of preparing the patient for psycho-therapy. Shock and drug treatments are viewed as rendering the patient amenable to analysis of his psyche.

The chief difficulty, or contradiction, in American psychiatry today appears to lie in the fact that brain-oriented psychiatry is limited to organic forms of mental illness, while our society produces many times more cases of functional mental illness. Brain psychiatry surrenders the domain of neuroses, by default, to the office analysts, the psycho-therapists. It is forced to do this because it does not have a comprehensive science of mental illness, one which would include neuroses as functional disturbances, rather than organic lesions, of the brain.

One available recourse for brain-oriented psychiatry in the United States, if it is to break out of its impasse, is seriously to investigate the science of higher nervous activity founded by Pavlov. This science offers the key to understanding functional mental illness as a chronic disturbance of cerebral functioning. It lays the basis for discovering the cause, the nervous mechanisms, underlying the subjective mental and behavioral symptoms of neuroses. By mastering this science American brain-oriented psychiatry can take back under its medical wing the domain of functional mental illness now surrendered to the subjective idealist schools of psychoanalysis and psycho-therapy. In this way it can cease to be subordinated to the analysis and the therapy of the psyche. And in this way it can transform American functional psychiatry into a fully developed *medical* science. In that event, a rational psycho-therapy would find its rightful place as a necessary supplement to scientific psychiatry, and to medicine as a whole*

This, then, appears to be the situation in American psychiatry which may be significant for the development of a fully scientific materialist approach in the field. It may not turn out to be as slow a process of transformation as one might expect. As a matter of fact, psychiatry may well lead in bringing the

* The most advanced position within this trend toward a materialist psychology and psychiatry in the United States is represented by two books: *Soviet Psychiatry* by Dr. Joseph Wortis, published in 1950; and *The Neurotic, His Inner and Outer Worlds* by Dr. Joseph Furst, published in 1954. In a sense the two books are necessary complements, one to another. Dr. Wortis furnishes the stress on the teachings of Pavlov, a feature lacking in Dr. Furst's work. While Dr. Furst furnishes the stress on Marxist science and especially the reflection theory of consciousness as applied to the specific conditions of life in the United States.

fully rounded Pavlovian science to our shores. For there is a catalytic agent at work in this field, which is lacking in physiology and psychology. That agent is the ever-growing incidence of mental illness in our nation together with the inability of psychiatry, or analysis, to cope with it. Popular demand is steadily mounting for an all-out campaign to defeat this number-one health hazard. It may well become sufficiently strong to guarantee a genuine search for effective approaches to mental illness regardless of their source. There are indications that such a search is already in progress and that the teachings of Pavlov will be given a sincere hearing. If this is indeed the case, and if the search develops major proportions, there could be little doubt of the outcome. The Pavlovian science of higher nervous activity would unquestionably soon emerge as the main alternative to defeat in the fight against the most crippling disease of all in our country, mental illness.

Based on the current state of affairs in physiology, psychology and psychiatry, the outlook for a scientific materialist approach in these fields is not by any means as negative as might at first appear. If the prime condition for progress is sharp internal contradiction, then all three fields are ready for important advances.

The big task now facing physiology, psychology and psychiatry in the United States would appear to be the uniting of actual experimental and clinical work with Pavlov's science of higher nervous activity. The situation in each field not only appears propitious for such a move, but absolutely requires it for the resolution of its own internal problems.

American psychology and psychiatry have behind them a fine heritage of materialism and a great tradition of experimentation on which to build. They have before them the sharpest struggles against the now dominant subjective and introspective schools, in the first instance Freudianism.

Chapter IX

EPILOGUE

IN THE FIRST CHAPTER it was said that there is today a discernible tendency for the various schools of psychology to gravitate around two giant figures, Pavlov and Freud. Each represents one of the two possible definitive approaches to the study of the human mind—the objective, experimental method and the subjective, introspective method. Pavlov stands for the first, Freud for the second. There are many intermediate approaches espoused by one or another school, but the current and growing trend is toward an ever sharper polarization.

Each of these magnetic poles lays exclusive claim to the title *science of psychology*. Each has powerful intellectual and institutional backing and exercises wide influence on a world scale. The question posed at the outset was, "Which claim is backed by the evidence?" To find the answer, it was proposed to investigate the life and work of each.

The first half of this project is now completed. It remains to summarize briefly the teachings of Pavlov, point out their significance, and then to make the transition to the study of the life and works of Sigmund Freud.

THE TEACHINGS OF PAVLOV

The first twenty-five years of Pavlov's long career as an experimental scientist were devoted to demonstrating that the nervous system controls the internal organic processes of blood circulation and digestion. As a result of this work, he made the first of a series of broad generalizations about the life processes of higher animals, including human beings. This first great generalization was that the brain, as the apex of the nervous system, regulates what he called the *internal environment,* the system of interrelated organs and glands, comprising the animal organism. As regulator of the internal environment, the task

of the brain is to achieve and maintain a dynamic equilibrium within the body. This principle was called *nervism*. According to it, the body is a synthetic whole in which the parts are regulated and coordinated by the brain through the apparatus of the entire nervous system. To discover the facts and laws of the nervous control of the internal environment, a new experimental method was required, and Pavlov devised the method of the chronic experiment which allowed experimental work to be carried out on the intact and healthy animal.

The second broad generalization, made in the course of some thirty years of experimental work on dogs and primates, was that the nervous system, and particularly the brain, establishes and regulates the relationship between the animal organism and the *external environment.* Thus the brain is the special organ for the adaptation of animal behavior to the conditions of life. To carry out this task, there are two nervous mechanisms. The first is concerned with certain adaptive reflexes which, in the course of the evolution of the given species, have become hereditary. This is the mechanism of the unconditioned reflexes. Unconditioned reflexes guarantee that the animal at birth will have minimal necessary behavioral adaptation to those more or less permanent conditions of life which have surrounded the species from its inception. The seat of the unconditioned reflex is the subcortex.

The second nervous mechanism to carry out the task of adapting behavior to the environment is the conditioned reflex. The discovery of this mechanism and its laws was perhaps Pavlov's greatest achievement. By means of the conditioned reflex the animal is enabled to adapt to the constantly changing features of the environment during the course of its own life. It is a mechanism for "learning" from experience. Sense stimuli, through temporarily formed connections, act as signs representing concrete external objects. By means of this sensory system of signals, animals make the most refined adjustments to the details of the surrounding world. No matter how subtle this adaptive behavior of animals becomes, however, it can be fully accounted for in terms of sensory signals without calling on the human qualities of thinking, reasoning, feeling or purposeful activity. The oppositely acting processes of excitation and inhi-

bition can make minute analyses of external agents by breaking down sense stimuli, and then can synthesize the latter into new conditioned reflex acts, resulting in new adaptations to the environment. The seat of all this conditioned reflex activity is the cerebral cortex.

In a third generalization, Pavlov combined the first two in a grand synthesis: the nervous system, primarily the brain and in particular the cerebral cortex, has the function of establishing and maintaining a dynamic equilibrium between the external and the internal environments. On the one side, it controls and guides such vital activity as feeding, protection and reproduction, including the complex processes of hunting for food, avoiding enemies, finding a mate and the care and training of offspring. On the other side, the brain coordinates this external activity with various states of the body, and at the same time regulates all the internal functioning of the organism. Thus the nervous system—the brain, the cortex, with the mechanisms of the unconditioned and conditioned reflexes—controls and coordinates all the life processes, external and internal, of the animal.

From his work with mental patients in the clinic, during the closing years of his life, Pavlov made a fourth broad generalization: in human beings there is, in addition to the sensory system of signals which they have in common with animals, a system of signalling by means of speech. Words are conditioned stimuli standing as signs for the sensory signals. Thus the speech system is built up on the base of the sensory system, and cannot exist apart from it. It marks a qualitatively higher relation between the organism and the environment. For while animals can "learn" from their own experience by means of the sensory system of signals, people not only learn that way but in addition can learn from the entire experience of mankind through spoken or written words acting as speech signals, and passed on from generation to generation. As conditioned stimuli, words make abstraction and generalization from sensory signals possible. By combining words into grammatical sentences, and sentences into logical arguments, the speech system makes possible reflection of external reality in the human mind. Reflection, tested back in the sensory signals obtained in social practice, is found to

be true or false, to correspond or not to correspond to reality. Thus the speech system makes possible the discovery of facts, laws and theories which truly reflect the nature of the external world. In short, the speech system, in closest relation to its base, the sensory system, is the nervous mechanism underlying thought, reasoning, purposeful activity and all forms of social consciousness, including technology, art and science. The human cerebral cortex is the seat of both the sensory and the speech systems of signalling reality.

Through his experimental work on animals and through his clinical work with mental patients, Pavlov was able to make a fifth broad generalization. The previous four generalizations concerned the regulative and adaptive functions of the nervous system, the brain and especially the cerebral cortex. The fifth, however, has to do with the *protection* of the nervous system and its apex. The cells of the brain, and in particular the cells of the cerebral cortex, are the most reactive of all the cells in the body, if not in all of nature, and therefore, are subject to periodic fatigue and to possible overstrain or to organic damage. There is of necessity a nervous mechanism for the protection of these vital cells. Pavlov called this mechanism *protective inhibition.* The most common form of protective inhibition is sleep. In sleep, inhibition spreads more or less rapidly through the cortex and down into the mid-brain to varying degrees. Its function is to restore from daily fatigue the reactivity of the cells of the nervous system, particularly of the brain and its cortex. A certain amount of protective inhibition in the form of sleep is required by the human organism during every twenty-four hour period.

Another form of protective inhibition, far less common than sleep, may set in as a result of excessive strain, profound emotional shock or of sharp mental conflict. It is an inhibition of the reactivity of cells which have been subjected to overstrain due to extreme demands put upon them. The function of such inhibition, which may be more or less localized, is to protect the already overstrained cells from further stress which might cause organic damage. This type of protective inhibition is one of the underlying higher nervous mechanisms of functional mental illnesses. Such illnesses involve no organic damage to

the cortical cells, but the mechanism preventing such damage itself in many cases constitutes a pathological condition. Localized protective inhibition accounts for many kinds of neuroses and psychoses, from very mild to extremely severe cases.

A sixth great generalization concerned functional mental illnesses of all kinds. From his work in the laboratory on experimental neuroses and from his work in the clinic with psychiatric patients, Pavlov concluded that the syndromes of mental illness are manifestations of more or less profound disturbances of the higher nervous activity. He defined neuroses and psychoses as chronic disturbances of cortical and subcortical processes lasting weeks, months or years. Thus, while many non-Pavlovian psychiatrists tend to concentrate on the symptoms of the disease, the disturbed behavior, thought and speech of patients, Pavlov concentrates on the nervous disturbances underlying and giving rise to the symptoms. This is analogous, on a very general level, to the difference between Marxist and non-Marxist political economists. Non-Marxists tend to concentrate on the appearances such as supply and demand, profit, wages and prices, while Marxists concentrate on the essential processes underlying and giving rise to the appearances, such as value, surplus value, value of labor power and value of the commodity. The symptoms of the various forms of mental illness are of great importance, and to the extent that non-Pavlovian psychiatry has discerned and clarified them, to that extent it has made a notable contribution to the science. But description and classification of appearances is only the initial stage of any science. A mature science is concerned with the essence of the given subject-matter expressed in verified facts and laws. Pavlov's discovery of certain of the higher nervous mechanisms which produce the syndromes of functional mental illness laid the basis for the transformation of psychiatry from the stage of classification and abstract system building into a mature science.

Pavlov was a doctor of medicine and in all his scientific work there was one dominant motivating passion, to make a contribution to the theory and practice of medicine, and thereby to the relief of human suffering. Because it was concerned with the treatment of illness, his seventh and final broad generalization was, to him, the culminating point in his long career. From

his work on the experimental neurosis in the laboratory, and from his work with mental patients in the clinic, he concluded that a number of those forms of functional mental illness, in which generalized or localized protective inhibition played a leading role, could be improved, relieved or cured through heightening the protective inhibition by means of various drugs in proper dosage. In particular, he found that protective inhibition in the form of induced profound and prolonged sleep was a highly effective treatment of certain types of neuroses and psychoses. This treatment is called *sleep therapy*.

Such are the broadest generalizations in the teachings of I. P. Pavlov. They form a rich heritage for the sciences of physiology, medicine, psychology and psychiatry. In addition, they contain important implications for pedagogy and philosophy, among other related areas of human knowledge.

Significance of Pavlov's Teachings

The significance of Pavlov's teachings cannot be fully grasped until they are placed in bold relief against the scientific and social background out of which they arose, and which still persists in at least half of the world.

In the closing decades of the nineteenth century there were three developments which at first sight might appear to be unrelated: first, the rise of imperialism; second, the rise of psychology as an independent discipline; and third, the rise of an apparently insuperable impasse in the physiology of the brain. With the rise of imperialism and the consequent sharpening of the class struggle, there came at the same time a requirement for new forms of bourgeois ideology all along the line. Monopoly exploitation and national oppression on the one hand, and economic and political organization of labor and its allies for resistance on the other, put new apologetic demands on ideological fields ranging from economic and political theory to philosophy and theology. To meet these demands, a new ideological foundation, supplementing the old religious one, had to be found. And it was ready at hand.

Psychology, but recently declaring its independence from philosophy and theology, was peculiarly suited to be the founda-

tion stone on which to erect the various forms of ideology required by the capitalist class in the era of imperialism. In the United States, psychology became an intellectual discipline separate from philosophy in the years between 1880 and 1900. Its very newness was a guarantee that it was not yet a science with a verified and generally accepted body of facts and laws. But there was a further and far more decisive reason why psychology was not yet, and could not for some time become, an established science. The subject matter of psychology is mental life and mental life is a function of the brain. Thus the physiology of the brain is the basis on which the science of psychology must of necessity rest. By the 1870's, however, physiology had come to an almost complete impasse in the study of the brain. Enough work had been done to make undeniable the fact that it is the organ of the human mind. But science was as yet powerless to determine just how the brain could give rise to mental life. The facts and laws of the operation of the brain as a whole were unknown and appeared unknowable. There seemed to be no method for penetrating into the cranium to discover its mode of functioning.

Deprived of a science of the brain as a basis, the new field of psychology was wide open for improvisation of all kinds of theories, including those which regardless of intent conformed more to the ideological requirements of the capitalist class than to objective reality. A characteristic of these latter theories was to carry on a super-militant struggle against the old religious conception of an unchanging, God-given immortal soul, and to do this by maintaining that the brain is the organ of the human mind, but then to proceed to pack the brain full of inborn mental traits of unchanging bourgeois man. In this way the content of the old religious approach to human nature was retained, while only the form was altered. It was possible to do this in large part because there was no adequate science of the brain and its functions which could contradict it.

A striking case in point is the psychological system devised by William James, generally credited with being the father of American psychology and with having no peer in our country down to the present time. Writing in 1885, James begins by denying the existence of the soul and asserting that the brain

is the organ of the mind. He then goes on to construct a theory of "the front door" and "the back door" of the brain. The front door is an undifferentiated stream of consciousness coming from the senses, while the back door is the inborn instincts, emotions and even the habits of bourgeois man. This hereditary and unchanging human nature includes: the instinct to acquire private property and to fight for its possession; the collection instinct; and pugnacious and aggressive instincts. The habit of being a gentleman or a worker is likewise inborn and hereditary. Regardless of the intentions of the author of such a theory, it lends itself to the purposes of those who would apologize for monopoly, war and the existence of classes by making them appear as the inevitable outcome of eternal inherent mental traits of man-in-general. Nothing can be done about it if man is just that way.

Thus psychology, unhampered by scientific laws and facts, can be utilized in the interests of a class. But a psychology such as that of William James serves purposes wider than the limits of the field itself. For it becomes the foundation stone for the construction of bourgeois ideology on many levels.

The James' type of packing of the brain with hereditary mental traits furnishes a rationalization for doctrines of supremacy on the basis of race, nationality and sex. The white, the United States and the male members of the species can on its basis be said to be born with superior brains. Not only the ideologies of white supremacy, chauvinism and male superiority find a theoretical foundation in this instinctive type of psychology, but in addition the doctrine of class supremacy. Capitalists are said to be owners and rulers because they have superior brains, while workers have inferior packing of the cranium. The diviison of society into classes is thus held to be due not to the nature of capitalism, but to cerebral differences.

In each case, instinct psychology lends itself to the purpose of taking the attention of the people off the search for real causes, off the economic, political and social conditions, and directing it inward to the brain and its supposedly inborn mental capacities and traits and conflicts. Psychologies based on instincts furnish much of the material from which the various forms of imperialist ideology are fashioned.

Thus psychology arose and developed along with the rise of imperialism and at a time when science stood powerless to resolve the mystery of the brain. These three facts combine to account for the central role played by psychology for the past fifty years in the ideological superstructure of U.S. capitalism.

It is against this background that the true significance of Pavlov's teachings is revealed. He went far toward resolving the mystery of the brain. Much more work remains to be done, but the mystery is largely gone. No longer does science stand powerless before the brain. It now has the theory, the method and already a body of facts and laws with which to proceed toward full understanding of the most complex and delicate organ of living matter.

In the Soviet Union, the twin pillars of idealist, instinct psychology in the service of reaction have been shattered. Capitalism has been eliminated, and Pavlovian science has triumphed, breaking the impasse in the physiology of the higher nervous processes. Psychology, free of its shackles, is taking long and sure strides on the road to becoming a science at last. The same holds true for psychiatry.

In the United States, the two pillars remain. Imperialism puts ever more reactionary demands on psychology and, for lack of familiarity with the science of higher nervous activity, the physiological basis of man's mental activity remains largely unknown. But in no sense does this mean that American psychology and psychiatry are marking time. On the contrary, the present is a period of profound change, particularly in psychiatry. Under the pressure of the rapidly mounting incidence of mental illness, many American psychiatrists are turning away from the purely mental approach and are becoming once again *medically* oriented. With the help of scientists from other fields they are conducting experiments that indicate a possible bio-chemical basis of mental illness. It appears to be one of those critical moments in a science when developments follow one another in quick succession.

An influential section of American psychiatry is currently stressing the bio-chemical approach to mental illness, while in the Soviet Union the physiological and patho-physiological orientation is considered primary. There is, of course, no reason

why these two approaches need be in any way mutually exclusive. On the contrary, full exchange of information on both sides would be to the great gain of each, and of medicine and science in general.

Pavlov's position with regard to psychology and psychiatry is that they cannot become exact sciences without basing themselves closely on the physiology and the patho-physiology of the higher nervous activity. Freud's position is that, though mental activity is a function of the brain, it is nevertheless an independent phenomenon, and that a scientific psychology and a scientific psychiatry can be constructed without benefit of cerebral physiology. We have examined the evidence for Pavlov's position and cannot but be impressed with it. We would suspect that Freud's teachings might be speculative, somewhat similar to those of William James. Our final conclusion, however, must wait on the examination of Freud's position in the second volume. This will be done with all possible objectivity, but at the same time critically. It will include an examination of Freud's teachings and those of his followers, and how the Freudian approach works out in various spheres of ideology.

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INDEX

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